EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1925

"The Heavens Declare the Glory of God"

How a Group of Enthusiasts Learned to Make Telescopes and Became Amateur Astronomers

By Albert G. Ingalls

"WHY not make your own telescope?" said Mr. R. W. Porter, the telescope maker, as the waiter in a famous Broadway chop house started for the kitchen with our order. "Astronomy would mean a lot more to you if you did."

We had met to talk about Porter's hobby, astronomy. I had already heard quite a lot about this versatile man whose whole life had centered about the study of the stars. In his earlier years he had spent a dozen winters in the Arctic as astronomer, topographer and artist. Three years he had been with Peary, three more with Fiala in Franz Josef Land, and two years with Cook, who Porter says certainly did not climb Mt. McKinley. Other seasons he spent in northwestern Canada and in unknown Labrador. During all these years in the Far North where the Arctic stars fairly snap in the cold, clear air, he was studying astronomy.

Now he had settled down in the picturesque manufacturing village of Springfield, Vermont, tucked away in a deep valley in the foothills of the Green Mountains, where, as everyone in the mechanical industry knows, a famous type of flat turret lathe is made. Here he had fired a score of men with his own keen enthusiasm for the stars and had organized them into a group which is perhaps unique —machinists by day, amateur astronomers by night.

"You'd have no trouble in making a good telescope," he assured me.

"I could make the mounting all right," I replied, "but when it came to making the optical parts I'd be out of it. Only a handful of men in the world are skilled enough to do that fine work."

"You come up to Springfield, where I live," he laughed, "and I'll show you a good many home-made telescopes, made in spare time by men who knew nothing about it when they began. They'll tell you how any amateur—even an editor—can make his own telescope for less than fifty dollars, providing he's reasonably handy and will take pains. And it will be a real telescope, fit for serious work, not just a toy or a makeshift."

The "Poor Man's Telescope"

He went on to tell me how in the Vermont village a group of men, most of them mechanics in the local machine shops, had banded together to study the stars; how each one had made and mounted his concave mirror; how they had later pooled their efforts and built a sort of combined clubhouse, lodge and observatory on the top of a mountain near their homes. Here they gathered when the week's work was done, to study the stars. "The Telescope Makers of Springfield," they call their club, and none may join who has not made his own telescope.

When summer rolled around, I went to Springfield, as Porter had suggested, and there the amateur astronomers told me how they had learned their new avocation.

There are two common types of telescopes, the refractor and the reflector. The refractor is the ordinary type that everyone knows. It is like a big spyglass; you look *through* it, the light actually passing through its lenses. For serious amateur work such a telescope, having an objective lens four inches in diameter, is very valuable, but it costs several hundred dollars to buy, while the ordinary amateur cannot hope to make it himself.

But the reflector works on a different principle. It is a shorter, thicker instrument having a large, round, concave mirror in its lower end. The light coming from a star strikes this concave mirror and is reflected upward in a converging cone. Near the upper end of the big tube, which is open at the top, a small diagonal mirror or sometimes a three-sided prism of glass is mounted in such a position that the cone of light reflected by the large mirror is intercepted and is turned at right angles toward the eyepiece in the side of the telescope. Owing to the fact that the light does not pass through the glass as in the other type of telescope, the mirror does not have to be made of optical glass—simply ordinary thick plate glass; and since the mounting of

ON THE SPRUCE-CLAD SUMMIT OF BREEZY MOUNTAIN THE VERMONT ASTRONOMERS HAVE BUILT THEIR STELLAR FANE. A SEVENTY-FIVE FOOT SOLAR TELESCOPE PROJECTS THE SUN'S IMAGE ON A SCREEN INDOORS

In this type of telescope, no tube is required. The light from the sun is reflected by the sixteen-inch, flat, pivoted mirror B, to an equally large concave, paraboloidal mirror mounted on a stone pier at A. Thence the light converges through a circular opening just above the first mirror, and focusses on the screen, C, where the amateurs study the sun's image

"THE HEAVENS DECLARE THE GLORY OF GOD"
So runs the biblical verse on the front of "Stellar Fane." Two reflecting telescopes show in the foreground

the telescope does not have to be very accurately constructed, this type of telescope may be made for fifty dollars or even less. Therefore it is called "the poor man's telescope." One having a six-inch mirror will magnify from 100 to 200 diameters, and more in transparent atmosphere, and will do really effective astronomical work.

The Springfield amateurs set to work enthusiastically, and before many weeks most of them had surprised themselves by making the most difficult part, the mirror. The best work was done by the elderly men of the group, for they proved to be most patient and painstaking and did not try to rush the job through. The only feminine member turned out an excellent mirror, without a scratch on its polished surface.

When the telescopes were completed the back yards of Springfield bristled like Mt. Wilson, the California mecca of astronomers, with heaven-pointed instruments. This was great fun, but the observers soon discovered that they were missing a lot because they and their telescopes were scattered. They were not within talking distance of one another.

Several expeditions to neighboring peaks resulted, the would-be astronomers and their wives, telescopes, coffee pots, frying pans and bean kettles, all partaking together. But shivering, shelterless nights on windy mountain tops set the telescope makers planning further. Why not buy one of these peaks, they asked themselves, and build a shelter on it, with a warm fireplace, cots and a kitchen, as well as a place to store the heavy telescopes when not in use? Thus resulted Stellar Fane, "The Temple of the Stars."

The Saturday afternoon of my visit we climbed the mountain in cars piled high with provisions, for at least half the fun in one of these astronomical jaunts to Stellar Fane is the gathering of the observers about the long board and the stowing away of acres of johnny cake and other good things prepared by one of the members, Mr. Redfield, the duly appointed "cook-laureate" of the club. His double title is due to the fact that with his edibles he also serves up poetry.

From the highway we passed through an ancient, rustic gate and churned our way spasmodically up across a boulder-strewn slope, and then up a steeper pitch. The radiator boiled furiously. The upper half of the peak was clad with virgin forest of birch and beech and black spruce, so that I got no glimpse of Stellar Fane until at last we came out on a level clearing at the summit. There, enclosed in a semi-circle of trees was the Fane, a bizarre little house with steeply sloping roof anchored to the solid rock at all four corners by means of steel cables in order to keep it from blowing entirely off the mountain.

A Close-up of the Sun

All around the north and west horizon stood a ring of wooded mountain peaks, thin blue in the distance and as untouched as the day before man was man. Not a sound came up from the world below to annoy the star lovers in their lofty retreat.

"That peak over there is Ascutney," Porter explained, "and just behind that ridge is the place where President Coolidge grew up. But let's go inside and look around—we've got some things in there that may interest you."

In the front of the building there was a long room, finished in gray-stained pine, timbers naked. On the walls were a few pictures of the moon and other celestial bodies. There were several astronomical drawings, and a small blackboard was built into one corner for use in demonstrating disputed points raised by the amateurs. Sundry books on astronomy were tucked into odd niches in the walls. A folding staircase led aloft somewhere. A massive, home-made table was decorated with sawed-out signs of the zodiac. One end of the room was crowded with reflecting telescopes of various shapes and sizes, waiting to be dragged out by their owners and set up on selected spots nearby for the night's observation.

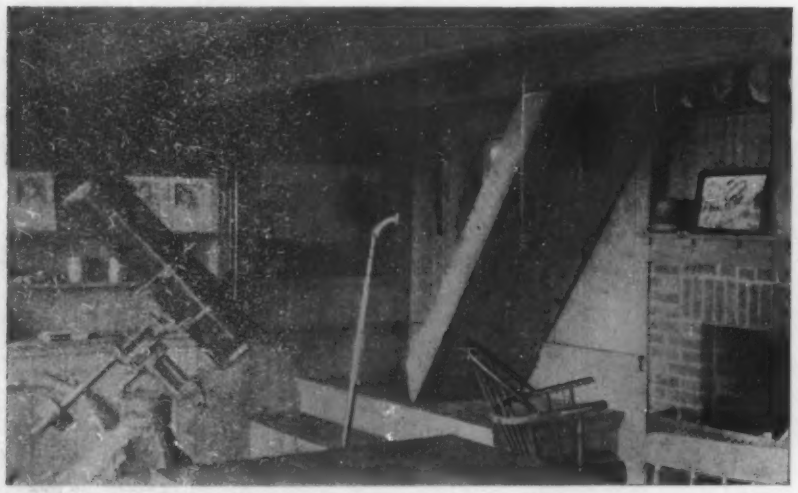
PORTER AND HIS SIX-INCH, TUBELESS TELESCOPE
Near the top, opposite the horizontal eyepiece, is a prism which reflects the converged light into the eyepiece

In the rear was a complete kitchen, with a work-bench at one end for quick repairs to damaged telescopes. Upstairs were two rooms, one packed with cots, the other used for the solar telescope.

"While the sun is still up," said Porter, "let's set up the solar telescope." He drew out a big flat, round mirror and attached it to a heavy bracket just outside the window opening. This mirror reflects the sun's light to another mirror on the ground, seventy-five feet distant. There is no telescope tube in this type of instrument, for none is necessary.

With a wheel and worm gear the flat mirror was moved into proper relation with the sun and the concave mirror back of the Fane, when suddenly a powerful shaft of sunlight bored into the darkened room and the beautiful, silvery image of the sun appeared on a perpendicular screen. Each separate sunspot and every prominent detail showed sharply and clearly.

"We gather around this screen," said Porter, "while one of us keeps the sun's image centered on it with this wheel. We can study old Sol's face here in comfort and with precision, and at night we can see the moon, too, but not so vividly."



THE COZY FRONT ROOM OF "STELLAR FANE"
Here, in the cloudy intervals of the night's outdoor vigil, the astronomers gather 'round the crackling hearth and talk about the stars. Fullam's ten-inch telescope shows in the corner

THE TRANSIT INSTRUMENT FOR OBTAINING STAR TIME
It extends through the wall of the Fane, the totally reflecting prism on its outer end catching the reflection of equatorial stars, which transit across the cross-hairs as the earth revolves

THE TEN-INCH, HARTNESS, REFRACTING, TURRET TELESCOPE

Described in the Scientific American, March 9, 1912. This type of mounting affords protection against both winter cold and summer insects. Porter says that but for former Governor Hartness there would be no "Telescope Makers of Springfield"

ONE OF THE TRIM, HOME-MADE REFLECTING TELESCOPES

While some chose wooden mountings, others, like Mr. Whitney who is a machinist, chose to use metal. Both types work well and are a delight to the eye. The metal from which this mounting was made was actually selected from the scrapheap!

By the time we got downstairs again the telescope makers had set up their instruments for the night's vigil.

"This fat, wooden one is Mr. Fullam's," said John Pierce, the vocational teacher at the Springfield School. "Fullam is a pattern maker, so naturally he used wood for his mounting, and it has proved very satisfactory."

"Here's Marshall," said the cook-laureate, "let's have a look at his telescope. He's a foreman in the shops."

Marshall's telescope is unique. Its main feature is its ever-upright eyepiece. With ordinary telescopes one often has to take up very awkward and tiresome positions to see stars directly overhead, but with a telescope like Marshall's you always look down into the eyepiece much as if it were a microscope.

The light reflected by the eight-inch main mirror is intercepted several inches short of its focus by means of a prism of glass which turns it through an angle of ninety degrees to a second prism, and this in turn turns it another ninety degrees into the eyepiece. Powers up to 560 diameters are available for exceptionally clear nights, though the 140 power is usually used. Provision is made for a driving clock in the turret, which is mounted on seventy-two steel balls. Marshall's telescope was a thoroughly workman-like job which took him two weeks to finish.

By the time I had inspected everything in sight and taken some photographs, it was dark. We all sat down at the long table inside and "stoked up" for the night with the cook-laureate's excellent provisions.

"There'll be another feed or two during the night," said one of the men, "for when we're not star gazing we're always eating."

One by one the telescope makers drifted away from the table, as I sat talking with a professor from a New England university who had motored over to visit Stellar Fane. Someone touched my arm.

"Come out and have a peep at Saturn," said Marshall, disappearing into the night. I followed him. There was Saturn, looking just like the Saturn of the pictures, but far more beautiful. Even the narrow Cassini division between the two pearly rings was clearly visible. Pretty good for an amateur's first telescope, is it not?

You Can Make a Telescope

Marshall now turned his telescope on Jupiter, revealing four of its satellites, tiny yellow balls whirling around the parent planet. Then we hunted up a spiral nebula, setting the two graduated circles on the telescope for the exact number of degrees and minutes called for in the ephemeris, the book which is used for locating the stars. With its spiral structure looking like a whirling pinwheel the nebula stood out sharp and clear, a whole universe of suns, distant so far that the light had required a million years to travel the 6,000,000,000,000,000,000 miles from it to our eye.

The night grew chill. Inside, a fire burned cheerfully on the hearth and someone had found a big, flat pan of johnny cake—"about a square mile of it," one remarked. I thought they ought to measure across Redfield's enormous pans in astronomer's terms, by light years.

I was getting dozy but someone brewed some heavy, black coffee as strong as dynamite, and guaranteed it to break up all desire for sleep. Pretty soon—for it was June with its short nights—the birds were chirping in the trees. Faint dawn.

"You haven't seen the moon yet," someone put in, "and it's just rising above the trees." Damon's six-inch telescope brought the moon's yellow face, now turning in the dawn to gray, right up into Vermont.

The lunar landscape forms a striking telescopic study. Men become so interested in its infinitude of minute detail that they spend years, nightly inspecting its volcanoes, craterlets, clefts, ridges, ramparts, rills, terraces, cracks, fault lines and cliffs, all of which look different from night to night as the sunlight strikes the moon at different angles.

So ended the night at Stellar Fane, and breakfast came on with the sun. A Vermont breakfast since time immemorial is traditionally incomplete unless topped off with pie. We didn't have pie, we had strawberry shortcake! Some folks say that men, when they are alone, will not bother to fix up fancy things to eat. They ought to put in a night at Stellar Fane.

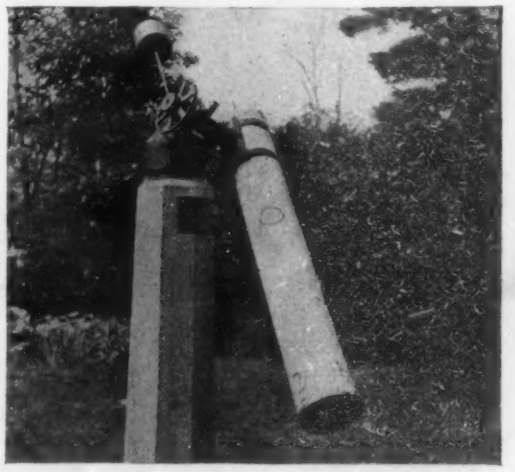
The next day we visited the workroom in Springfield, where some of the telescope mirrors were made. We silvered a telescope mirror, ten inches in diameter—at least I watched Porter do it. This job, often said to be tedious, took only twenty-five minutes. It requires a few chemicals, not many; and a willingness to take pains and to follow directions minutely. In fact, from those with whom I talked and from work which I have subsequently done I have gathered that the whole art of making telescopes is pretty much a matter of taking pains. You must be handy, of course, but you do not have to be a genius. Patience is necessary, but no knowledge of mathematics, abstruse science or astronomy itself is required for telescope making.

The tools are simply a barrel to work on, two inexpensive plate glass disks, a bit of common pitch, half a dollar's worth of optical rouge, a very few household tools, about four dollars' worth of abrasive, and your two hands to keep the upper disk moving back and forth over the lower one.

Provided enough of our readers write and request it—as some have already—we shall endeavor to publish an article telling how to go about the making of a reflecting telescope.

CHARLES LONGE'S TUBELESS REFLECTOR

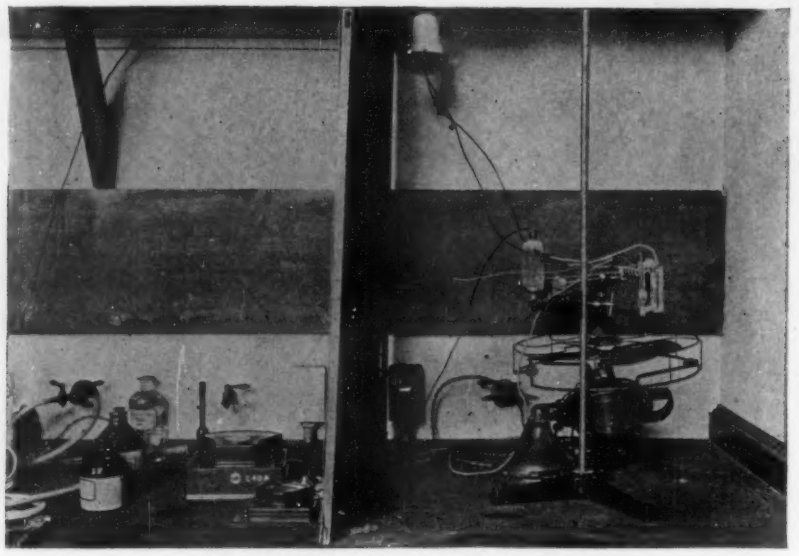
The mounting does not have to be as trim and accurate as this. A simple, wooden mounting without graduated circles suffices for the beginner's purposes and it costs little



MARSHALL'S PORTER-TYPE REFLECTOR

As the eyepiece is always in the same position, no matter what the angle of the tube, one's position is always comfortable. The mirror is in the bottom of the tube

ONE OF THE SPECIAL LAMPS
Mr. Estey is holding the lamp. Dr. Sheldon is in the center, Dr. Free on the right

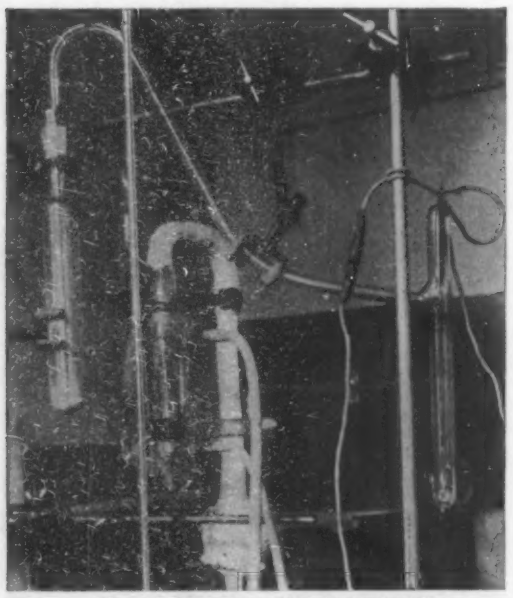


THE MIETHE LAMP READY FOR USE
The fan underneath the lamp creates a current of air for cooling

Tests Fail to Confirm Transmutation to Gold

A Report of the Scientific American Gold Test

EARLY in 1924, Professor Adolphe Miethe, of the Charlottenburg Technical College, in Germany, announced that he had solved the time-honored problem of transmuting one of the base metals into gold. According to Professor Miethe's report if a quantity of pure mercury—the familiar liquid quicksilver—was exposed for several hours to the action of an intense electric arc inside a vessel of quartz, a small proportion of this mercury was transmuted into gold. Following a suggestion of Professor Soddy, the distinguished expert on radioactivity, it was assumed that this transmutation was effected by the introduction of an extra electron into the nucleus of the atom of mercury. This extra electron would have the effect, Professor Soddy pointed out, of decreasing the effective positive electric charge carried by the nucleus of the atom and thus altering the atomic structure. It was believed that this alteration might be of exactly the right sort to make the atom resemble, thereafter, an atom of gold instead of an atom of mercury.



THE STILL USED FOR MERCURY
Vacuum distillation was used for purification

It was immediately obvious, both to scientists and to financiers, that if this remarkable experiment of Professor Miethe was really true, it constituted no less than a scientific revolution. Although Professor Miethe did not claim that any large proportion of the mercury used by him had been converted into gold or that the process was cheap enough to offer any immediate promise of decreasing the monetary value of gold, it was apparent, nevertheless, that this beginning might lead to cheaper and more practical processes, the final result of which might easily be a very real threat toward the gold standard now accepted as the financial basis of practically the entire civilized world.

The Tests Begun

Feeling itself obligated to discover the truth of this matter, both in the interest of science and of finance, the Scientific American arranged during the latter part of 1924 for a comprehensive and exact test of the results announced by Professor Miethe. Arrangements were made with Professor H. H. Sheldon, Chairman of the Department of Physics of Washington Square College of New York University, for the use of space and facilities in the laboratories of that college. Mr. Roger S. Estey, an experienced physicist and research investigator, was retained to conduct the actual experimentation, under the direction of Dr. Sheldon. Work was begun in December, 1924, and has continued ever since, the Scientific American supplying a portion of the necessary funds and all of its own facilities.

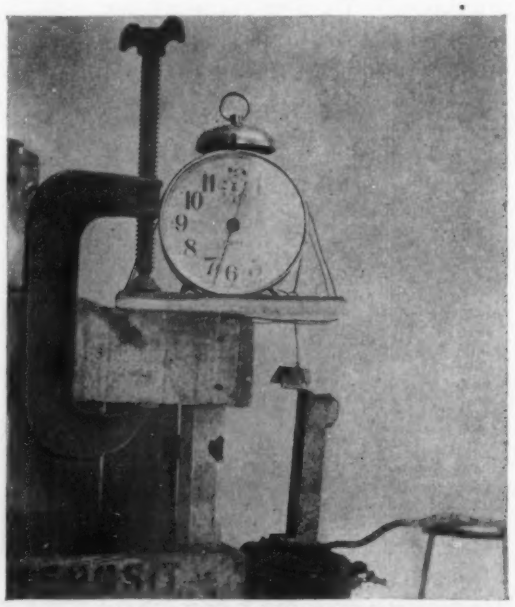
The result of this investigation may now be announced. It is an entire failure to confirm the transmutation of mercury into gold, as announced by Professor Miethe.

Feeling that the matter of greatest basic importance was the confirmation of the fact of transmutation rather than the duplication of any one way of doing it, Dr. Sheldon and Mr. Estey began their investigation by making use of a special lamp, designed by them and built out of fused quartz by the Cooper-Hewitt Lamp Company. We wish to acknowledge, gratefully, the valuable assistance of Mr. R. D. Maily and other scientists of that company in the design and construction of this lamp.

This lamp was so designed that a quantity of liquid mercury, contained in the quartz tube, could be heated to the boiling point and an intense electric arc passed through the hot vapor of mercury. This was substantially the process employed by Professor Miethe. The current was admitted to the lamp by means of tungsten electrodes sealed into the quartz walls. In this manner, any possible contamination of the mercury with gold contained as an impurity in the electrodes was avoided.

In order to avoid a possible error due to the accidental presence of gold in the mercury itself, arrangements were made for a supply of mercury naturally free from any gold impurity. The fact of this freedom from gold was then confirmed by the most careful chemical tests. As an additional precaution, the mercury was redistilled under vacuum. This especially purified supply of mercury, containing no determinable trace of gold, was used in all of the subsequent experiments.

The materials being in readiness, the new form of quartz lamp, designed and constructed as just described, was operated for three separate runs, rang-



HOW TIME WAS RECORDED
A magnetic device recorded the hours run

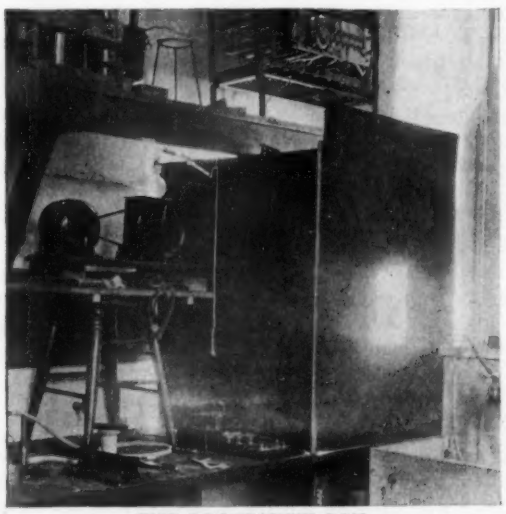
ing from 30 hours to 50 hours each. The voltage employed was approximately 170 volts and the strength of the current was approximately 13 amperes.

At the end of each of these runs the mercury was removed from the lamp and carefully tested for gold. In no instance was any trace of gold detected.

There arose immediately a question as to whether the analytical methods employed were adequate to detect small traces of gold. To make sure that they were, a small weighed quantity of gold was dissolved in a portion of mercury and then recovered by analysis. The methods were thus confirmed.

According to Professor Miethe's reports, taken in connection with the theoretical interpretation of Professor Soddy, this experiment should have produced a substantial quantity of gold; at least ten times as much as could easily have been detected by the analytical methods used. The negative result of the three experiments established, therefore, a strong probability that the transmutation announced by Professor Miethe could not be confirmed.

There was, however, one important difference between these experiments and the experiments reported by Professor Miethe. This difference was in the type of lamp employed. It was believed by Dr. Sheldon and by all of us, that the new lamp especially designed for these experiments was much more satisfactory than the type of lamp employed by Professor Miethe. A somewhat greater concentration of the electric forces in the arc was obtained and, also, the new lamp did not offer as great a chance for the accidental introduction of impurities from the electrodes as was the case, in theory at least, with the lamp employed by Professor Miethe. In Professor Miethe's lamp, for example, the elec-



THE PROTECTIVE BOX
Dangerous ultra-violet rays were kept inside

trodes were a combination of iron and carbon; whereas in our lamp the only material employed for electrodes was tungsten.

Nevertheless, in spite of the feeling that the new lamp employed by us was really preferable, arrangements were made to procure from the manufacturers in Germany an exact replica of the lamp used and described by Professor Miethe. On the arrival of this lamp, further experiments were made with it, employing the exact technique described by Professor Miethe, and culminating in a final run of the lamp for 172 hours. The voltage employed was between 165 and 174 volts, depending upon the temperature of the lamp. The current passed was approximately 12 amperes. These are exactly the conditions described by Professor Miethe for his own experiments.

As in the case of the previous experiments with our own lamp, this final run proved entirely negative. As before, the mercury employed was a part of the supply containing no determinable impurity of gold. After the run the most careful analytical tests failed to show any trace whatsoever of the precious metal.

It is necessary to conclude, therefore, that the experiment described by Professor Miethe does not always result in the transmutation of mercury atoms into gold atoms. The experiments recorded by Professor Miethe and our own experiments, conducted so far as humanly possible in exactly the method described by Professor Miethe, are entirely discordant with each other.

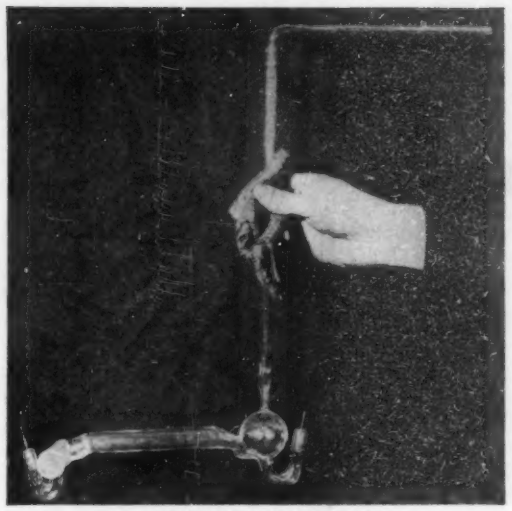
It would be improper to assert on the basis of these results alone, that Professor Miethe's experiments have been proved to be definitely wrong. All that it is proper to say is that a careful, competent, and long continued effort to confirm the German results has resulted in an entire failure to do so.

Nor is it incumbent upon us to decide why, (if at all) Professor Miethe's results are in error. We may perhaps be permitted to state, however, that one

A HOOD FOR FURTHER PROTECTION
Rays from the lamp would cause sunburn

very vital possibility of mistake in experiments of this character lies in the accidental presence of a small impurity of gold in the mercury employed. Discovering very early in our work, that such small traces of gold cannot be removed from mercury completely by any known process of distillation, Dr. Sheldon and Mr. Estey arranged, as has been noted, to obtain a supply of mercury coming from a naturally gold-free source. The problem of initial purification was thus tremendously simplified. It does not appear that this particular precaution was observed by Professor Miethe. Indeed it may not have been possible for him to observe it, since supplies of gold-free mercury are not plentiful in nature. While we do not assume (at least in advance of the final technical papers of Dr. Sheldon and Mr. Estey) that the accidental presence of gold in the original mercury was really the source of the gold which Professor Miethe found and which he assumed to have been created by transmutation, it is at least possible that such was the case.

The truth or falsity of this suggested explanation for the failure to confirm Professor Miethe's announcement will appear, doubtless, as Professor Miethe's results are subjected to further criticism and test in his own laboratory and in the laboratories of other German universities. Perhaps it will be discovered that some minor and unnoticed detail in the arrangement of the apparatus or in the conduct of the experiment was really responsible for a successful transmutation in Professor Miethe's case; a transmutation which does not occur when another

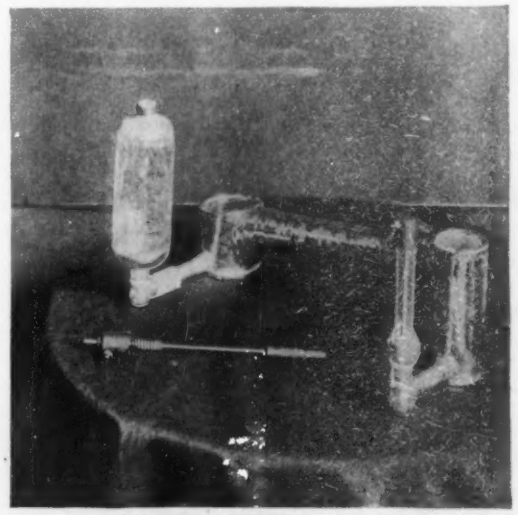


A SPECIAL FORM OF LAMP
This form was designed and made for these tests

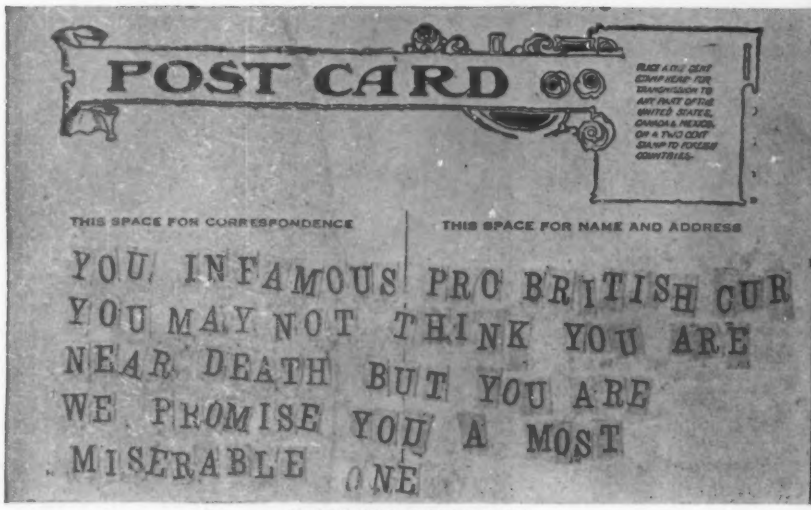
experiment is performed in exact accordance with the published description, but lacking this essential and unknown detail. We must confess, however, that we do not believe that this will prove to be the case. On the basis of all of the evidence now available, including the experiments of Dr. Sheldon and Mr. Estey which are here reported, it is our belief that a transmutation of mercury atoms into gold atoms does not occur and will not occur under the conditions which have been described by Professor Miethe.

It is to be freely admitted, of course, that a transmutation of mercury atoms into gold atoms is a theoretical possibility. The internal structures of the two atoms are similar. The removal of one unit of positive electric charge from the nucleus of a mercury atom, or the insertion of one additional electron into this atomic nucleus would result, it is believed, in the conversion of the mercury atom into an atom indistinguishable from the ordinary atoms of gold. Quite aside from the failure to confirm the results of Professor Miethe, it remains entirely possible that one of these changes of atomic structure can be accomplished by some physical or chemical method yet to be discovered.

For the present, however, there is no visible threat of this transmutation being accomplished by any process sufficiently easy to permit the manufacture of cheap gold. Neither from Professor Miethe's results, nor from any other facts now visible on the scientific horizon, does there arise any immediate threat of a decrease in the value of gold which would threaten the gold standard of money or the present financial structure of the world.

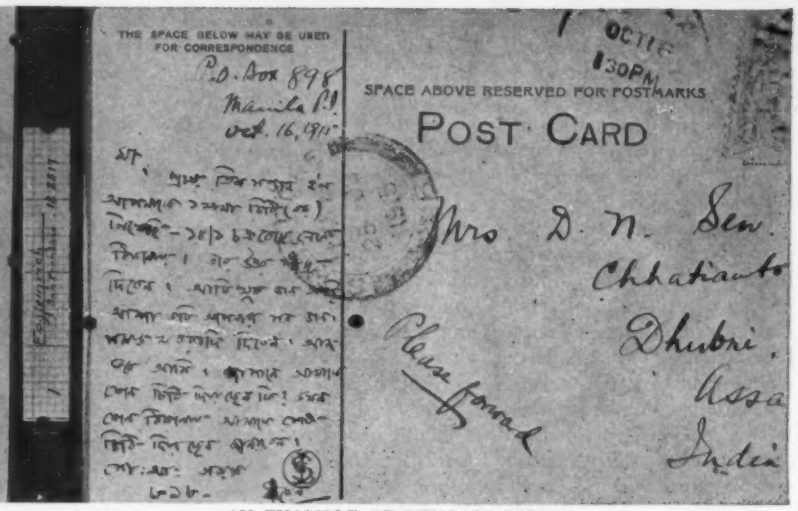


MIETHE'S FORM OF LAMP
One of the iron and carbon electrodes lies in front



AN ANONYMOUS THREAT

This card was sent to Attorney Preston during the trial of the Hindu-Ghadr cases. The identity of the sender was proved by Mr. Heinrich and he was convicted



AN EXAMPLE OF BENGALI SCRIPT

This bit of evidence figured conspicuously in the trial of the Hindu-Ghadr Revolution Plot cases. Dr. Heinrich is not a linguist, nevertheless, he was able to establish its authorship

Every Crime Is Entrenched Behind a Lie

How the Lie Is Punctured and the Criminal Exposed Is Described in This Interview With the Noted Criminologist, Edward O. Heinrich

By Tom White

OFTEN when truth seems entirely "crushed to earth," she needs some assistance in the effort to "rise again." It is not alone in questions of suspected or disputed signatures that the aid of the expert criminologist is sought; it is in the test tube and the crucible, or through the lens of the microscope and the camera that the expert in crime detection finds the evidence of poison, the trace of the deadly bullet, the identity of a clot, the source of a fiber, the telltale fingerprint, the differing ink, the slip of the pen, upon which have depended the rightful title to an estate or the liberty of an individual.

Edward Oscar Heinrich, B.S., consulting criminologist of Berkeley, California, and recognized authority throughout the country, particularly in the far west, is still a young man, notwithstanding a notable record in establishing identities from seeming trivialities. His office is in San Francisco; his home on one of the loftiest hills in Berkeley, across the bay, and it was here in his laboratory in the basement where he received me.

Lying the First Mistep

"You are proving every day, Mr. Heinrich, that it's virtually impossible to get away with crime, aren't you?" I asked.

"Yes, and no," he replied. "What I am proving almost every day is that crime is entrenched behind a lie; puncture the lie and the criminal is disclosed."

"Granting that such close relationship is found between falsehood and crime, it is your belief, then, that the criminal is developed first and, in order to cover his misdeeds, he takes to lying?"

"Ultimately, yes; chronologically, no. The lie comes first.

"The mind of a child is the most sensitive, the most receptive organism known to science. It is continually reaching out, first for impressions, then for experience. A child's earliest impressions are gained from what he is told or has read to him, and it has pleased fond parents for ages past to fill the young mind with all sorts of tales which constitute the youngster's realm of make-believe.

"Meantime the child is commencing to exercise one of the most potent forces in his development; the natural desire to mimic. This desire should certainly be encouraged, but it should be most carefully guided along proper channels. Later, he learns that the tales he has heard are not true. This means the loss of some of his fondest ideals, but if his ideals have been of the right sort, these ideals will be carried with him instinctively right on into young manhood.

"However, his playmate next door, whose make-believe has been allowed free rein, is going to imitate what by that time may be *his* ideals, and when he goes too far with his wrong sort of play he will most likely resort to a lie in order to escape punishment. Then, if his first little lie seems to help him out of a hole, he will try it again, and if he is not found out and the tendency checked, by the time he is in his 'teens' the habit will become so deep-rooted as to be second nature to him. Lying is just the first step in the wrong direction.

A Sherlock Holmes in Real Life

With only the slenderest of clues, can an expert build up a perfect case that unravels a mystery and convicts a criminal? Some of us may have doubted that the exploits of a Sherlock Holmes could be found outside of a work of fiction, but here we have a man who has made the detection of crime a science. The separate items of every event all harmonize, he reasons. Where there has been any attempt to distort the facts, though it be ever so clever, there always is one discordant note. It may be a letter slightly out of plumb that is revealed only when the forged typewriting is held under the microscope, or a scratch on a bullet found in the temple of the slain man, but the false note is always present.

"Speaking of lies; here's a splendid example." We walked over to the opposite wall where hung a number of photographic enlargements of handwriting. "Incidentally, the lie was punctured, the document proven a forgery and the perpetrator brought to justice. This writing is magnified thirty diameters. Sheet Number 1 shows part of one of the pages which constituted the original will; Number 2, the forgery. See how the letter 'm' starts here and here? And how almost exactly it is like the same letter in sheet Number 1? Almost, but not quite. It lacks truth because he has traced back in an attempt to patch.

"The same sort of case has been made out against a man making typewriter alterations and interlineations on a typewritten document, for it has been pretty well established and recognized that when it comes to individuality, a typewriter can display nearly as many characteristics as a pen.

Examiner Need Not Be Linguist

"One case in particular I recall. The authorship of an alleged contract for $20,000 was traced and the document proved to be a forgery. This was done with the aid of the photomicrograph. The typewriter was too new to have developed a great many marks of identity in its work, but there were more than enough. As I remember it, the letters 'y,' 'g,' and 'n' were unmistakably scarred. By laying a protractor over the work it was found that the letter 'l' was several degrees 'off its feet,' and the letter 'd' sagged a little below the line."

"Is it any more difficult, Mr. Heinrich, to detect a forgery when the writing is done in a foreign language? And is it necessary that the examiner be an accomplished linquist?"

"No—to both questions. During the World War enemy agents busied themselves in an attempt to hatch a nasty brood of troubles for John Bull, and by making their headquarters in San Francisco, Uncle Sam was drawn into it. The idea was to stir up enough strife to warrant sending troops to India, thereby making that many less effectives available for use on the western front. This was known as the Hindu-Ghadr Revolution Plot.

"During the trial of these cases I served the United States and British governments jointly. Examinations were made and authorship established of documents and papers written in Bengali, Gurmukhi, Hindustani, Urdu, German, Spanish and English, and I lay no claim to being a linguist." He had produced some sheets of paper with lines of characters that resembled shorthand notes all jammed up tight.

"This is Bengali script. Do you see how this W-like character is formed? And this one that looks like the letter V? See how it is joined to the next character in every case? These are some of the peculiarities of this man's writing which helped to clear up a great many questions and to convict him.

"In work of this kind, while it is not essential that an examiner should be a linguist, it is necessary that the fundamental movements by which writing is executed be thoroughly understood. If the forger makes the least bit of a slip, if there is evidence of any hesitation or doubt in the forming of a letter, and particularly if he goes back and patches up his work, there is enough to excite suspicion. The photomicrograph magnifies the writing twenty or thirty diameters and each letter is studied until we know the writing is either genuine or a forgery."

Identity Established Two Years After Burial

Last fall Heinrich assisted the district attorney in the Rhinehart case. The defendant had been accused of the fatal shooting of Sergeant Brady of the San Francisco police. An alibi had been built up, but suspicion was strongly against the defendant. In his apartment had been found an ordinary revolver. Heinrich secured two bullets from the body of the victim. These, subjected to a microscopic test, revealed tiny grooves down the sides of each. There was a marked coincidence between these two grooves and certain defects on one of the "lands" within the revolver barrel.

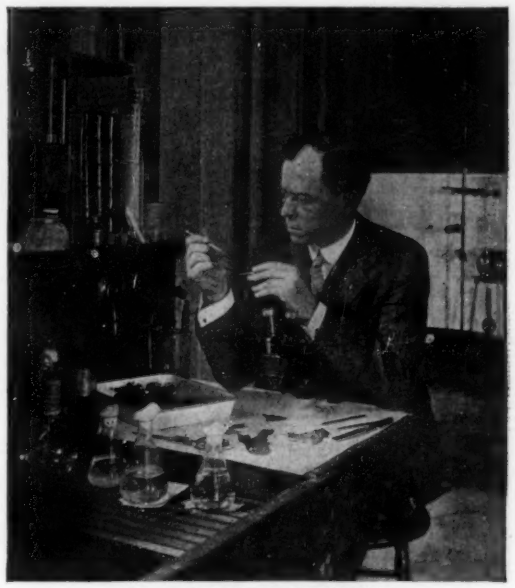
"But these scratched bullets," I queried, "you say there is quite a definite relation between these marks and the defects in the gun barrel. But how was it conclusively proved they were shot from this particular gun?"

"It was quite simple," Heinrich explained. "Another bullet forced through the barrel showed marks identical with those on the first two."

Only the day before Heinrich had returned from a lengthy stay in the southern part of the state.

"The district attorney called me down there to reconstruct the remains of a man who had been buried for two years, and so establish his identity," he said. "Lying just outside of town was a small place recently taken over by new owners. A strawstack had stood in one corner, but it had been moved to make way for crops. When the space was irrigated, a marked depression showed in the ground; it looked suspiciously like a grave. Some bones were dug up. Then I was sent for.

"The skull had been badly fractured, which indicated foul play. It was not difficult to estimate closely the man's height and weight, as certain bones have a fixed relation to size. His arms were unusually long; one of them had been broken. His age was revealed through his hair. Two teeth in the lower jar were deeply worn, as if by a pipe stem.



DR. EDWARD O. HEINRICH
He is examining a bit of charred paper

Gradually, piece by piece, the man's identity was established.

"It seemed that in 1923 a man by the name of Barney Wood, a well-known character in his community, disappeared. It was said he had been in the habit of carrying with him a sizeable sum of money. The inference was obvious.

I had followed this case in the newspaper. It had developed that Heinrich had built up an exact picture of the missing man, Wood. Even the detail of the broken arm had been verified by a man who had been present when the accident occurred.

"It is not generally known that a man's approximate age may be determined by the tubular composition of the hair. In this case I estimated the man to be from fifty to sixty years old; official records placed his age at fifty-five."

"What, in your opinion, is the greatest aid to crime against property—meaning robbery?"

"Those who furnish an outlet for disposing of the loot—'fences,' they are usually called."

"And what is the most effective way of dealing with these fellows?"

"Going after the man higher up. A striking case in point occurred a few years ago. A desperate gang—safe-crackers and vault-tappers—traveled extensively in the Pacific Northwest getting away with bonds and securities. The king-pin was a man in Portland, Oregon, who was buying these securities from them as fast as they turned them in. They were registered, too, but that didn't seem to bother him: he would alter or erase the registration numbers. Quick resales were made through a string of pawnbrokers. Before long the traffic grew to such an extent that a quiet investigation was started. A number of suspicious looking bonds were collected. Chemical restorations revealed the deleted writing.

"Then we began working backward. Soon our man was arrested, tried and convicted. But here, too, as is so often the case with the 'big fellows,' this man had developed a great deal of political power. His first move was an attempt to have the conviction quashed. Failing that, he appealed to the Congressman from his district, and a friend of his even went so far as to carry the case to the President with a petition for executive clemency. The President refused to act. When the doors had closed behind him all the little fellows quit. Not only was their source of supply suddenly dried up, but they were plainly scared.

"Where this principle has been applied to the enforcement of the prohibition law it has worked quickly and thoroughly, but the situation requires kid-glove handling rather than strong-arm methods. However, when the quietus is applied to the ringleaders, the little fellows will *have* to quit."

"Now, Mr. Heinrich, is the so-called crime wave, in your opinion, advancing or receding?"

"In my opinion there is no such thing as a crime wave. Those crimes, which have been classified as such, maintain a consistent ratio to the population. In a state like California, where the population is increasing steadily, we find crime on the increase, but the ratio remains constant. In a slowly growing community it generally is found that the proportion of criminal and population figures is standing still.

Unpopular Laws Cause of Increasing Crime

"On the other hand, there is a pseudo increase in crime due to new laws which classify certain behavior as offences which, until a few years ago, were not so classified. This includes prohibition statutes and laws regulating automobile traffic. While it is just as much of a transgression to break the laws having to do with these as to break the laws of one of the older enactments, when these new laws are broken, the resultant crime can hardly be said to represent a change in human character.

"In this connection we must not lose sight of the fact that erring humanity, which is really trying to improve, is daily faced by a widening array of pressure and criticism of a general character that is difficult for either an individual or society at large adequately to meet, especially when it is of the impractical sort."

"You think then, do you, Mr. Heinrich, that the race really is gaining a little in quality and tone?"

"Unquestionably. But we have a long, long way to go before we can afford to stop and pat ourselves on the back."

"AND THEREBY HANGS A TALE"
Each of these objects was a slender clue from which the Bureau of Missing Persons of the New York Police Department traced the identity of a dead man

A SMALL BOY'S FIND
By means of a dental plate, members of the New York Police Department identified this skull as that of a man who had disappeared more than a year before

Our Point of View

The Aeronautical Crisis

IT WOULD be a fatal error to abandon lighter-than-air navigation because of the *Shenandoah* tragedy. To do so would be to lose all the capital, technical knowledge, and work which the Government, through the Navy, has already put into the airship, and abandon the development of airship travel to other nations. This would be to put the stigma of faint-heartedness and failure upon the American people, who have ever prided themselves upon their initiative, mechanical genius and courage.

In the midst of the shock, bewilderment, and grief for the dead in the *Shenandoah* disaster, the nation should preserve its self-control and patience and await the results of the broad investigation of the very able commission, appointed by the President, and await also the technical findings of the naval experts, who are piecing together the experiences of the survivors and gathering the valuable lessons which can be learned from a study of the wreck of the ship itself.

We believe that apart from its value as a naval scout, which has yet to be fully determined, the airship has an assured future for transatlantic and other transoceanic travel. For such service it must be built of even greater dimensions than before. The bigger the ship, the greater, relatively, is the amount of weight that can be spared for the hull structure. Hence, it follows that the big ship is relatively stronger, and better able to resist those bending and twisting stresses which broke the *Shenandoah* into three separate parts. Furthermore, if the risks of inflammable hydrogen can, by careful and preventive design, be eliminated, and both the Germans and the British claim that they can (the British, indeed, are now building two hydrogen-filled ships of more than double the size of the *Shenandoah)* there will be from seven to ten percent more lift obtained from a given volume of gas. Here, also, there would be more weight available for insuring the strength of the hull structure. Indeed, we shall not be surprised if investigation shows that in a hydrogen-filled ship of 5,000,000 cubic feet capacity, it is possible to provide a double hull and thus secure a great increase of strength, such as is given to the merchant ship by its double bottom and to the warship by its complete double hull below the waterline.

Furthermore, there is but little risk of encountering at sea destructive vertical line storms of the kind that occur over the land. This fact, coupled with the greater strength of the larger ships of the future and the more complete development of weather forecasting, makes the problem of ocean airship travel fairly sure of solution in the not far distant future.

In the *Los Angeles*, our Navy Department possesses a ship well suited for testing the commercial development of airships. She has made a successful crossing of the Atlantic; she has sailed to Bermuda and anchored for a whole day in a 40-mile gale to the mast of the *Patoka* and then returned to her home port at Lakehurst. The Lakehurst hangar should be continued in service and the Navy should be permitted to continue to make experimental voyages for the gathering of data. Furthermore, our aeronautical officers, both those who design and those who fly the ships, should be granted the necessary appropriations to enable them to embody the structural lessons taught by the loss of the *Shenandoah* in a larger ship designed as a scout and suitable for commercial travel across the Atlantic. That such travel will come we do not doubt. America has, in abundance, the necessary wealth to develop commercial airship navigation. The question is, does she also possess the necessary courage and persistency?

Let us be fair to the airship. We did not cease to build long-span bridges because the Quebec Bridge fell down; we did not countermand all orders for large steamships when an iceberg ripped open the *Titanic* and sent her to the bottom; nor did we cease to lay tracks and build locomotives and cars because of the frequent and tragic collisions in our early railroad history. So, in the present case, we must above all things avoid panic legislation. It was an accident of the weather and not a defect in the *Shenandoah* that caused her collapse; it was another accident of the weather which prevented the *PN-9* from reaching Honolulu. In the one case the ship, for the want of full radio weather forecasts, ran right into a storm of which she had no warning, a storm, furthermore, of the kind which the designers of the ship had warned would probably destroy her —which it did. In the other case, the favorable trade winds which were relied upon to help the *PN-9* on her long trip simply petered out—a most unusual occurrence—and instead of blowing with her, the winds, during the later part of the course, were contrary, and by holding the ship back caused her to run out of fuel. It was the weather, we repeat, and not any structural fault either in the *Shenandoah* or the *PN-9* that defeated them.

Let us keep our heads in this matter and not be misled by the latest outburst of Colonel Mitchell which may be regarded as an altogether insignificant incident in the great question of the future of American aviation. The only feature in Colonel Mitchell's attitude that is not insignificant is his glaring indiscretion and the shameless example of insubordination which, as high ranking military officer, he has given to the country at the very time when resistance to authority is a growing menace among the young people of America. It is not Colonel Mitchell's silly outburst which has caused the President to appoint a special commission. This was done because the loss of the *Shenandoah* has rendered necessary a dispassionate inquiry such as will now be made.

The Slaughter of Peace

Everybody knows that an increasing number of people is being killed by the automobile, and apparently the majority of people are not very deeply disturbed by the fact. But if they saw thrown on the screen a list of the Americans killed and wounded in the late war, and side by side with it saw a list of the killed and wounded in automobile accidents, they would be shocked, surely, to learn that the slaughter of peace through misuse of the automobile is comparable in magnitude to the slaughter of war. Thoughtlessness and indifference are two of the outstanding and greatly-to-be-regretted facts which confront anyone who makes a thoughtful study of modern conditions, and especially conditions which have obtained since the war. What is everybody's business is nobody's business; and there are too many people who dismiss the question of the rising tide of automobile fatalities by the flippant remark: "Well—if people will drive carelessly and others will wander across busy streets with indifference to their own safety, that is their look-out and they must take the consequences." The question, however, is too broad to be dismissed with a few flippant words; and in answer to the question: "Am I my brother's keeper?" considerations of mere humanity thunder the reply: "You are; and you should do everything within your power to save him from danger and disaster, even when they are due to his own folly."

Something is being done, notably by the Hoover Conference; and next December there will be turned in the reports of committees which have been making a close study of the problem, in the hope of determining what practices and prohibitions will best conduce to safety under the existing conditions. Legislation will not save a man from himself; but personal and neighborly exhortation to observe the regulations for street and highway safety, as laid down by municipalities, by the police, and by such an organization as Mr. Hoover's committee, will go far to cut down the present most shocking death rate.

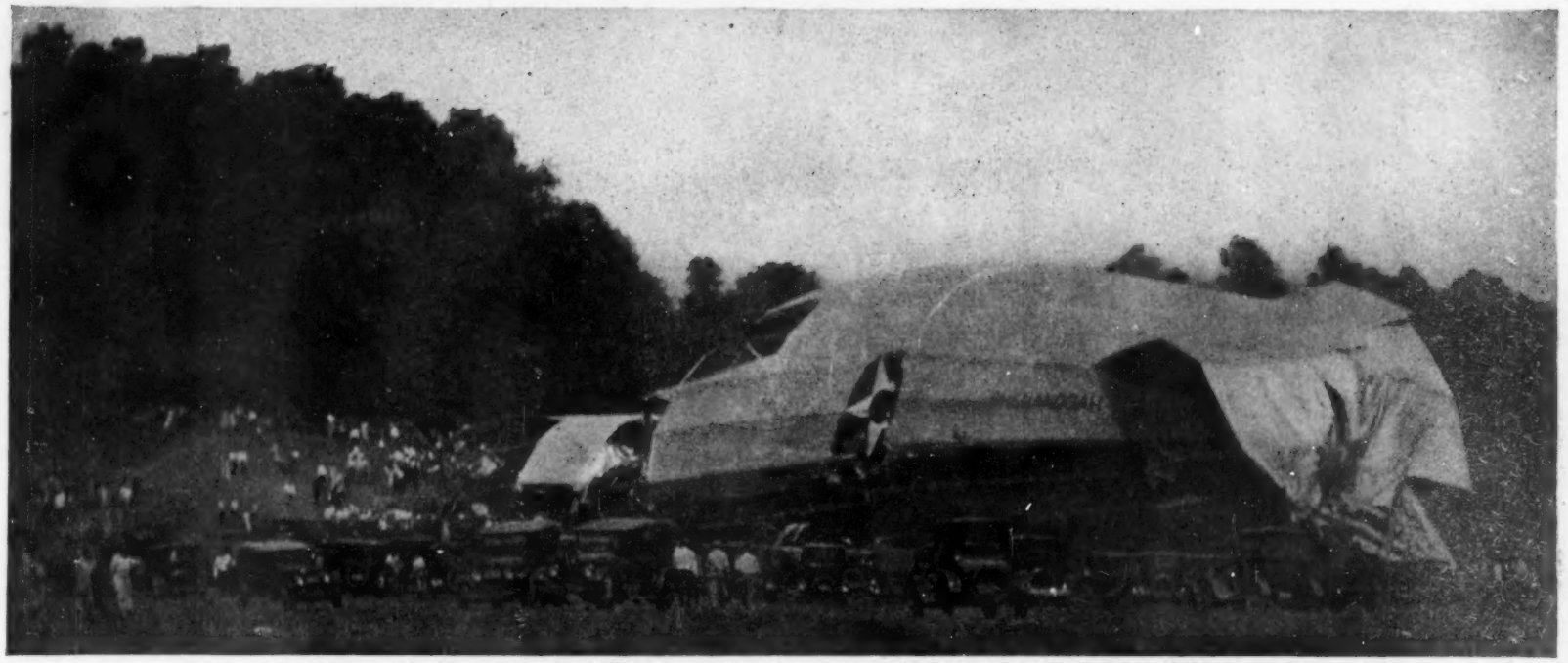
How to Make Rain

WE had not thought of David Starr Jordan as a humorist; but the following, on "the art of pluviculture"—the interpretation whereof is "how to make rain"—gives us another thought.

Thus, in *Science*, he has his pluviculturist build a modest shack in which to prepare certain chemicals in accordance with a secret formula which might be as follows: ten pounds of pulverized chlorate of potash and an equal amount of granular cane sugar mixed carefully in a wooden tub, with a pint of sulphuric acid poured over them. Dr. Jordan informs us that this simple preparation will produce surprising results which might be brilliantly enhanced by using a pound of magnesium ribbon, to one end of which a lighted match had been applied, the whole being sent into the air by attachment to a skyrocket. The next suggestion is that the rain-maker might insure himself through Lloyd's against a rainless day.

The above is about as reasonable a proposition as the many which periodically come from the would-be rain-makers. Dr. Jordan quotes Barnum's classic statement that there is "a sucker born every minute"; and with this he couples Herbert Spencer's statement that "to save men from the consequences of their folly would fill the world with fools."

Nevertheless, we have the rain-maker with us still, and his voice will be heard in the land for many a long year to come. He is own brother to the perpetual-motion enthusiast, the wielder of the divining rod, the astrologer, and the multitudinous and variegated army of crankdom. So persistently do people run after the sooth-sayer and the magic worker, that we think it might be a good thing if someone would endow in our schools and universities a chair for the teaching of common "horse sense."



After section of the Shenandoah. She fell, tail down. Crumpling up of tail (right) eased the shock and saved the personnel

The Tragedy of the "Shenandoah"

The Wrecking of This Superb and Well-tried Ship by a Furious Thunderstorm

By J. Bernard Walker

THE loss of the *Shenandoah* is not chargeable to her construction, which embodied all the experience of the Germans and the British and improvements made by our own naval constructors. With the exception of the *Los Angeles*, she was the strongest dirigible ever built, and Captain Heiman's silly charges about insufficient valves notwithstanding, she was in absolutely first-class working condition when she set out on her last and fatal voyage.

Nor is her loss chargeable to faulty operation. Her captain, Commander Lansdowne, was the most experienced of our dirigible pilots, and he was assisted by a capable and well-trained staff and crew, who knew their ship. The testimony of the survivors is unanimous that the conduct of the whole personnel in the tremendous emergency, both before and after the breaking up of the ship, upheld the finest traditions of the naval service. Everything that was humanly possible was done to avert disaster.

Her loss is chargeable to her encountering, unwarned, that most dreaded of all weather phenomena, a "line storm"—a vast wall of uprushing air—which flung her 4,000 feet upward into the heavens, as though she were a shaving of wood caught in a spouting geyser of water.

An airship is by far the frailest of all mechanical constructions of great size that men's hands have fashioned. It may be likened to an eggshell filled with gas. Elongate the eggshell to a cigar-like form; thin out the shell to the point where it would be so light that the gas would lift it, and you will get some idea, rather crude and inexact, of the relative fragility of an airship's shell or "frame."

Moreover, the integrity of this delicate framework depends upon its being everywhere, throughout its length of nearly 700 feet, supported by the upward pressure of the bags of gas within it. Deflate two or three bags in the center and the ship will sag under the unsupported local load and break in two. Deflate the bags at the ends and the ends will drop, setting up a vertical bending stress, that will hog the ship and break her back. Unlike a bridge, the airship cannot run a web of trussing from top to bottom, thus utilizing her great depth to gain girder strength. The gas bags are in the way.

Hence the airship has but little strength to resist bending stresses, either in a vertical or a horizontal plane. That other great tragedy, at Hull, England, to the *ZR-2* was caused by throwing the helm over suddenly, when the ship was at high speed. The

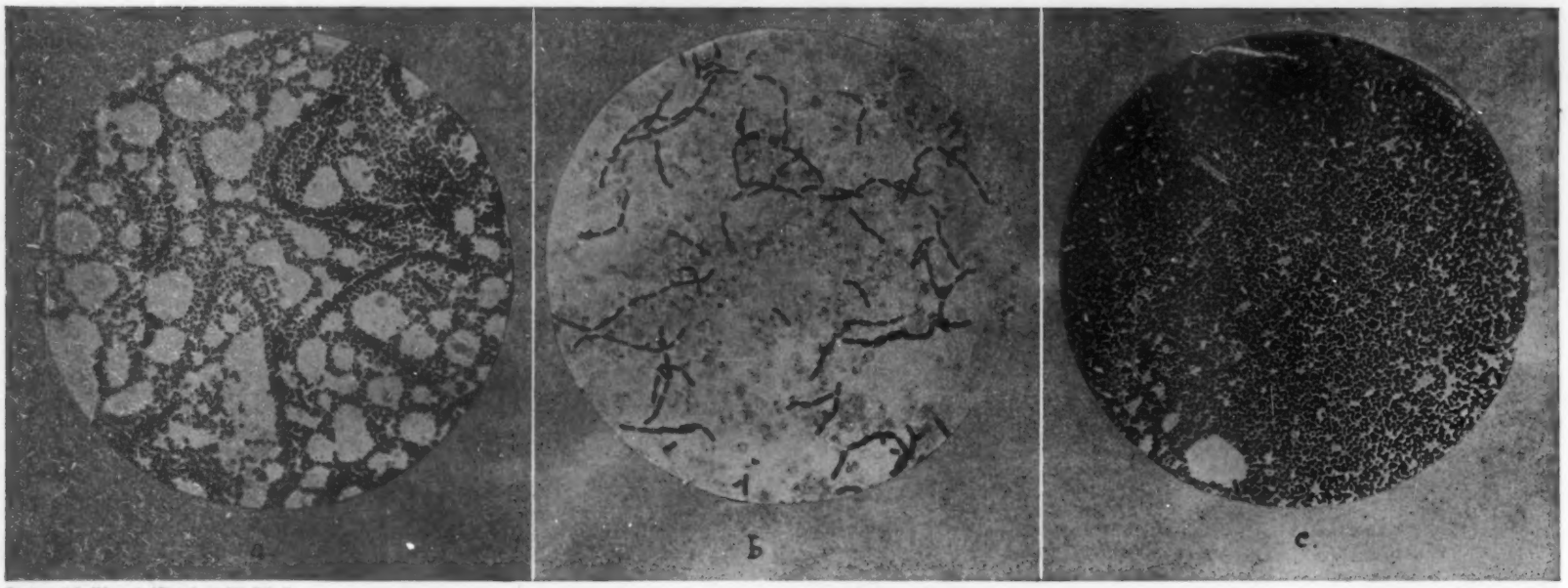
LOOKING INTO THE BREAK
Forward view of wreck of tail portion

sudden lateral pressure of the rudder set up a heavy lateral bending strain in the frame. It broke clear across.

In the case of the *Shenandoah*, when she drove her nose into the uprushing column of air, the sudden and violent upward thrust on her forward part, resisted by the inertia of, say, the after two-thirds of the hull, set up a violent vertical bending stress, which undoubtedly weakened her structure. She was swept rapidly upwards from the 3,000-foot level to about 7,000 feet. Commander Lansdowne valved her freely, pointed her nose down with engines running, and she came down with such rapidity that he had to discharge water ballast in large quantities and order the dropping of gas tanks. She was brought to a level keel at about 3,000 feet. Here she suddenly broke in two at a frame 250 feet from her bow, probably at a point already overstressed when she first struck the squall. She broke also at a point 75 feet forward of this and near the control car, which had been sheared off and fell, killing everyone in it. The 75-foot section, with gas bags deflated, fell swiftly, throwing out its occupants. The nose (forward portion 175 feet long), relieved of the weight of the control car, rose, and the personnel, by valving, brought it to earth. The after section, fortunately fell tail first, and the crushing up of the tail served to cushion the fall. The occupants of this portion were saved. What caused the breakup when the ship had been straightened out at the 3,000-foot level? Probably an upward or downward gust of air striking a hammer-blow upon the already over-stressed frame, and thereby setting up severe bending stresses which proved fatal.

Bear well in mind that the loss of the *Shenandoah* does not prove that successful airship navigation is a failure. So far as navigation over the sea is concerned, line storms of the violent nature of that which wrecked the ship do not occur over the ocean. The lesson is that in navigation over the land, where they do occur, an adequate radio weather service is imperative. The Government protects marine navigation by a weather service, by lighthouses, by radio compass bearings, etc., that are unsurpassed. It should do the same for aerial navigation.

On the score of human responsibility, we close by suggesting that Congress ask itself how far its amazing failure to assist aviation by organizing an adequate aerial weather report service and other crying necessities, may have contributed to this harrowing disaster.



Courtesy of the "Journal of Experimental Medicine"

DYES THAT PICK AND CHOOSE

These are photographs of bacteria made through a microscope. The bacteria are magnified many times. Two types of germs can be plainly recognized: (a) the very black, chain-like broken rods and the much smaller elongated dots, not unlike fly specks. When a mixture of these two kinds of bacteria was treated with a certain aniline dye and then planted on agar-agar, the ensuing growth (b) consisted entirely of the broken rod germ, the other (the "fly speck") having been killed by the dye. Similarly, using the same mixture of bacteria but a different dye, the result (c) was reversed; the broken rod organism was killed by this dye and the ensuing growth consisted entirely of the "fly speck" organism.

Fighting Disease With Aniline Dyes

Physicians Have Found a New Way to Reach and Combat Some Microbes

By Nell Ray Clarke

ANILINE dyes—the same kind that are responsible for the vivid summer costumes—are now being used also to cure infected wounds and blood-poisoning. The chemists who worked so strenuously during and after the World War in order that our hats and dresses would remain as bright in color at the end of the summer season as they are when we burst forth with them at Easter, were, without knowing it, doing profound work toward the advancement of medicine.

A few years ago it was discovered that certain dyes destroyed germs and parasites. This discovery came about in connection with the use of stains to color disease germs in medical laboratories in order to study them. The scientist found that after he had grown the little microbes they were too pale to be seen when smeared on clear glass and put under the microscope. So he began staining them so that he could see them.

Next, he discovered that in working with live germs certain dyes caused certain kinds of bacteria to cease moving about. Then the bacteria ceased to reproduce or to send out spores. Next, they ceased to nourish themselves. Finally they died. By varying the type of dye and the species of bacteria, the experiments assumed fascinating proportions. The inference naturally came about that if the dyes killed germs in the laboratory, why would they not kill germs in the body?

Certain dyes, known in medical and chemical circles as acid fuchsine, acriflavine, gentian violet, acriviolet, mercurochrome, which in practice dye things respectively purplish red, bright yellow, bluish violet, a deep violet and an orange red, have been found to kill or inhibit disease germs called by such unpronounceable names as staphylococcus aureus, streptococcus hemolyticus, streptococcus viridans, and so on—germs which cause accumulations of pus, or splenic fever, or arthritis with pus at the joints, as the case may be.

Just exactly what the dye does to the bacteria is still undetermined, but it is believed that it lessens their resistance and thereby permits the natural germicidal power of the body to come into play.

Hunting a Better Antiseptic

Despite the fact that several antiseptic substances have long been in successful use, physicians have for years been experimenting in the attempt to discover new substances which, though equally effective, would not have certain drawbacks. Bichloride of mercury, for example, kills bacteria on the surface, but it does not penetrate tissue. Iodine, another valuable antiseptic, is irritating and kills tissue cells as well as bacteria.

In many laboratories throughout the world the search is now being made for a substance which will kill bacteria without harming the tissues, which will penetrate tissues and which even may be injected into the blood.

For several years before the World War, scientists had been interested in the aniline dyes because they possessed many of these valuable properties. The war quickly stimulated this interest, for dyes were widely used in treating war wounds. Since the war, further advances have been made in the treatment of infections with dyes.

The main scientific contributions on which these advances rest have come from the laboratories of Ehrlich, Morgenroth and Browning in Europe; and in America from the laboratories of Johns Hopkins and Cornell Universities.

It is of advances thus made in America that the accompanying article so interestingly treats.

Doctors are the most careful people in the world about announcing that they have discovered something which is a cure for certain types of diseases, because they feel that it is not ethical to build up hope when such a statement might be a false alarm. A sufficient number of cases, however, are beginning to pile up to prove the efficacy of dye for local sterilization of infected tissue and surfaces.

The intravenous use of dyes, though still in its infancy, may revolutionize our ideas of antisepsis and enable us to combat septicemia, or blood-poisoning, more successfully than we have been able to do heretofore.

Dr. John W. Churchman, of the Cornell University Medical School, who has been one of the most brilliant pioneers in both fields, refuses to say that the intravenous use of dyes is yet successful, though he cites cases in which recovery has followed their use. So careful is he not to err on the wrong side that he even calls to mind the possibility that such cases may be coincidences.

One of the greatest factors, however, in the lack of success of the intravenous use of dyes is believed to be that so little is as yet actually known about the quantity of the chemical which a human being can stand that often the intravenous injection is not resorted to as a measure of relief until all other means have failed and the body is in too weakened a condition to react properly.

On the other hand, Dr. Churchman relates that a child, fifteen months old, suffering from severe bacillary dysentery, inflammation of the middle ear, and abscesses, and showing indications of blood-poisoning, was admitted to the hospital. For three weeks before intravenous treatment with gentian violet had been resorted to the baby had grown steadily worse. His temperature had reached 106 degrees and he was apparently dying. Blood cultures showed ten colonies of pus-forming bacteria per cubic centimeter of blood. This is considered to indicate a massive infection. Twenty-four hours after one injection of gentian violet the blood

cultures were sterile; and after the third injection, the enormously enlarged spleen became normal, the temperature fell, the abscesses began to heal, and in two months the baby was entirely well.

The main advantage which the aniline dyes seem to have over the common satisfactory antiseptics is that they are not so irritating as iodine, bichloride of mercury, and others. From a commercial and practical point of view they can be made in America from American dye intermediates. In case of war, therefore, we will not be dependent upon foreign countries, as we now are for most of our supplies, for antiseptics.

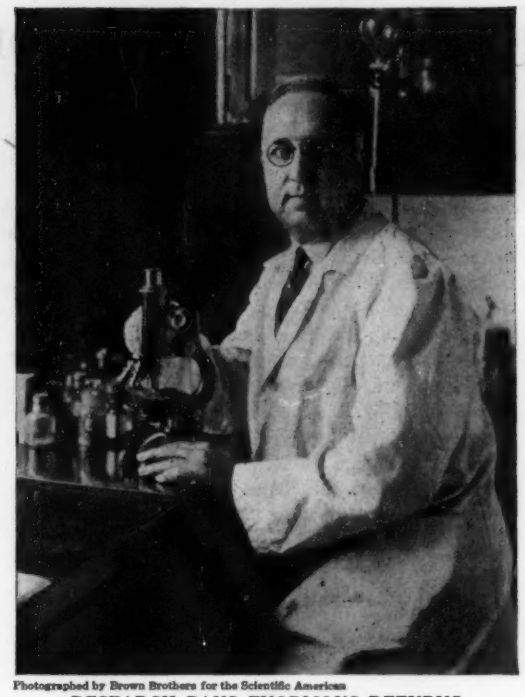
From the point of view of the research expert the dyes have several other advantages: by reason of certain characteristics peculiar to them they provide a means for the detailed study of the mechanism of antisepsis; they have certain useful properties not possessed by other antiseptics; and they lend themselves to chemical study in accordance with the molecular theories of Ehrlich.

Dyes Are Selective

For convenience, students have divided all organisms into Gram-positive and Gram-negative groups, the Gram-positive being those which when stained with gentian violet, retain their color after treatment with iodine. Gentian violet has been found to have a selective affinity for Gram-positive organisms, while acriflavine is somewhat more efficacious against Gram-negative organisms than against certain types of Gram-positives. A mixture of these two dyes (acriviolet) appears to combine the selective powers of the two components. Thus, the weakness of each when used alone is fortified by the strength of the other in the mixture.

One decided point of superiority of the acriviolet and similar dyes over other disinfecting agents is its penetrating quality, which makes it valuable in killing organisms in the tissues. Dr. Churchman reports that loops of intestine isolated between ligatures have been distended with gentian violet and the stain observed, while the abdomen was open, as it penetrated the inner coats. If the outer coats were slightly injured it actually was seen to ooze through the intestine and was blotted up with gauze on the outside.

There are also on record cases of apparent cures



Photographed by Brown Brothers for the Scientific American

RESEARCH PAYS ENORMOUS RETURNS TO HUMANITY

In scores of secluded research laboratories scientists are at work prying into secrets that they hope will rid man of disease. Dr. Churchman has spent years in research on the germicidal power of aniline dyes

of venereal diseases in women by the use of acriviolet.

It must be borne in mind, however, that dyes must reach the organisms which they are expected to kill, a requirement which it is sometimes difficult to fulfill, especially in the case of an infected joint.

After a number of men had died at Walter Reed Hospital, Dr. Churchman undertook to cure, by means of dye solutions, soldiers whose amputation stumps had become infected with bacillus diphtheriae. Every known treatment (including large doses of antitoxin) had been tried on two men who had continued for weeks to have positive cultures. He did the job with gentian violet in a short time, but he could not heal up the amputation stumps infected with bacillus coli—which shows that these dyes are "picky and choosy" about what they kill, or as the doctors put it, they are selective.

Whether or not the adaptation of a particular dye to the particular microorganism present is going to become one of the principles upon which the use of dyes for antiseptic purposes is based remains yet to be determined. One experimenter, however, has found that sodium hydroxymercurobenzophenone-sulphate is the most effective agent for infections of the middle ear. If there is anything in a name, that dye ought to kill some of the most potent germs.

Much Experimentation Still Necessary

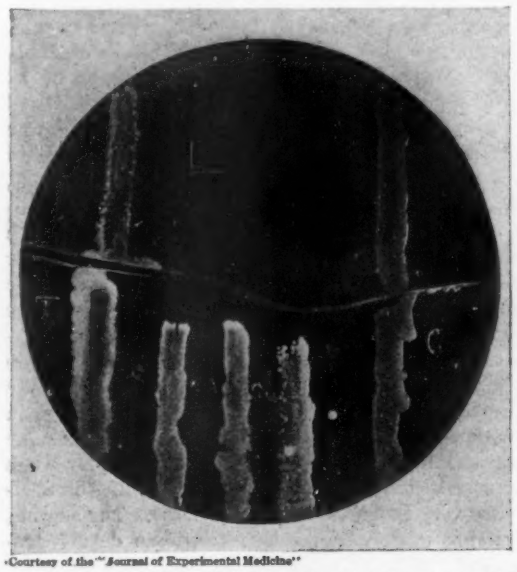
It is hoped that some of the dyes, besides being bactericidal, will also prove to possess inhibitory power in the body. In line with this reasoning, it is on record that when an acriviolet soaked gauze had been inserted in the wound at the operation the tissue in the sinus of a post-operative wound following a mastoid operation was quite sterile at the first dressing ten days after the operation. It is possible, therefore, to leave such an antiseptic in sensitive cavities, a thing which could not be done with iodine or with bichloride of mercury. If this property of dyes is borne out by further advances, it will make them infinitely more valuable.

Up to the present time, solutions of the dyes have been used in the treatment of human beings only in such strengths as do not approach the danger line. Doctors do not yet know how strong they can make the solutions and get the best results; but, of course, no chances can be taken.

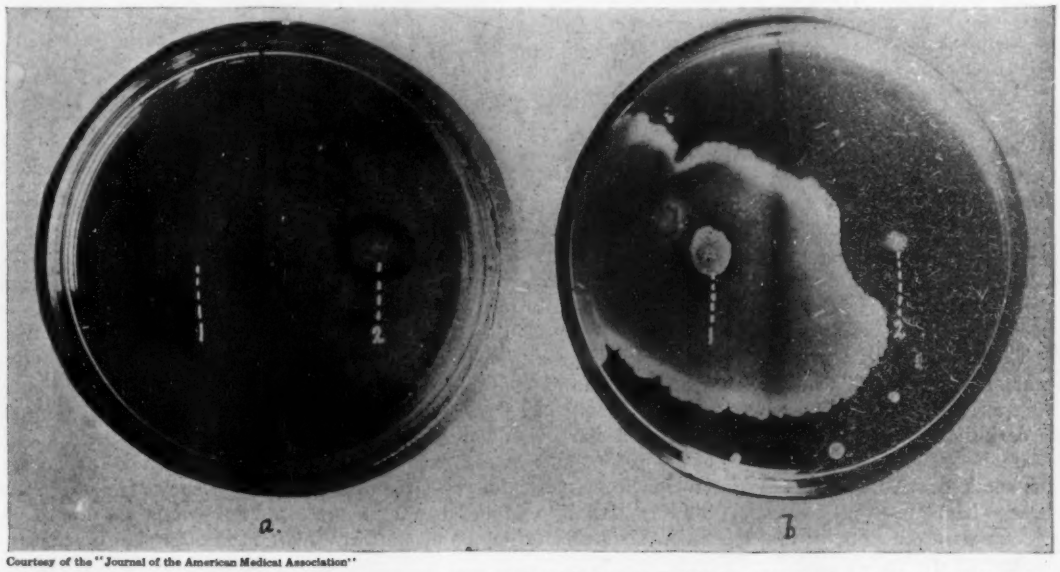
Before this knowledge can be arrived at, much experimentation on animals will have to be done.

Though the dyes are generally described as non-irritating, solutions of them must be made much weaker for use in certain parts of the body than for others. For example, gentian violet must be much weaker for use in the bladder or in the nose than for the throat, granulating wounds, or the antrum; and the same thing is probably true of other dyes.

Dyes must, like all other antiseptics, be used with a proper regard for the principles of surgical management of infection, but there is undoubtedly sufficient evidence of their features of inhibition and penetration, coupled with their non-irritating properties, to encourage their use in the treatment of surface infections.



Courtesy of the "Journal of Experimental Medicine"



Courtesy of the "Journal of the American Medical Association"

DYES ACT SELECTIVELY. THEY ARE ALMOST WITHOUT EFFECT ON THE GROWTH OF SOME GERMS WHILE THEY WHOLLY PREVENT THAT OF OTHERS

LEFT: *The plate here photographed consists of two parts. The upper part (above the irregular line which crosses from side to side of the picture) contains agar-agar to which dye had been added; the lower half contains agar-agar without dye. Five different germs were planted in strokes across the plate, which was then put in the incubator so that the germs could grow. The photograph was made at the end of 24 hours. The two germs at either end have grown as well in the agar-agar which contained dye as in the plain agar-agar; whereas the three germs in the center have not grown at all where the dye is present. The pictures in the center and on the right show the restraining effect of the dye, gentian violet, on the growth of bacteria. The photographs represent plates of agar-agar, a gelatin-like substance on which bacteria grow very well.* CENTER: *Two tiny droplets of a culture of bacteria, hardly visible, at (1) and (2), have been planted on the surface of the agar-agar; around one of them (2) a circle of dye was drawn, but not around the other. The plate was put away in an incubator and at the end of 24 hours a photograph was made.* RIGHT: *The unringed droplet (1) had now spread over the plate like a white cloud; but the other droplet, though it can be plainly seen that the bacteria have grown to a certain extent that proves it alive, could not pass the surrounding ring of dye, which acted as a deadly barrier. Notice that the growth of the droplet (1) also ceases when the neighborhood of the dye is reached, the germs tending to keep at a safe distance.*

Nova Pictoris—A Temporary Star

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mount Wilson Observatory, California

AT the date of writing this article, probably the most interesting thing, from the observational side, is the continued brightness of the latest temporary star, Nova Pictoris. If this remarkable object had not been sixty-two degrees south of the celestial equator—and hence invisible in northern lands—it would have attracted much public attention for, at best, last June, it was of the first magnitude and one of the most conspicuous stars in the southern sky.

The present nova, which was first seen in May, is unusual among such objects, on account of the exceptional slowness of its changes. A typical "new star" like the great one in Aquila in 1918 rises to full brightness in a very few days and fades away rapidly, losing nine-tenths of its light in a few weeks. In the present case, the corresponding changes run into months.

The history of the star before its discovery has been followed, as is so often now the case, for more than thirty years in the past, with the aid of the unrivalled library of photographs at Harvard. A faint star, in exactly the position of the later bright object, and clearly identical with it, appears on photographs taken in 1889 and 1890, at the Harvard station at Arequipa and on plates made in every year from 1894 to 1924. During all this time the star remained of the same brightness, of photographic magnitude 12.7—that is, about three hundred times fainter than the faintest objects visible to the unaided eye. It was still of this brightness at the end of 1924. When next photographed, on April 13, 1925, it was of the third magnitude—about 8,000 times brighter than previously. How much earlier than that date it brightened up or how rapidly, no one knows; and for six weeks afterwards it was missed, being low in the morning sky and it was not until May 27 that the next observations were made. The star was then of magnitude 2.3 and increased gradually until June 9, when it reached the first magnitude. It then fell to the second magnitude in a week, dropped to the third on June 20 and remained of about the same brightness, with irregular fluctuations, until well on in July.

Far Brighter Than the Sun

This star, therefore, must be reckoned among the most prominent of the temporary stars. Its brightness at maximum does not equal the great novæ in Perseus in 1901, or in Aquila in 1918, but exceeds all others for a long time; and the long duration of its visibility—certainly more than three months above the third magnitude—indicates that the whole amount of energy which it has radiated is, in all probability, unusually great.

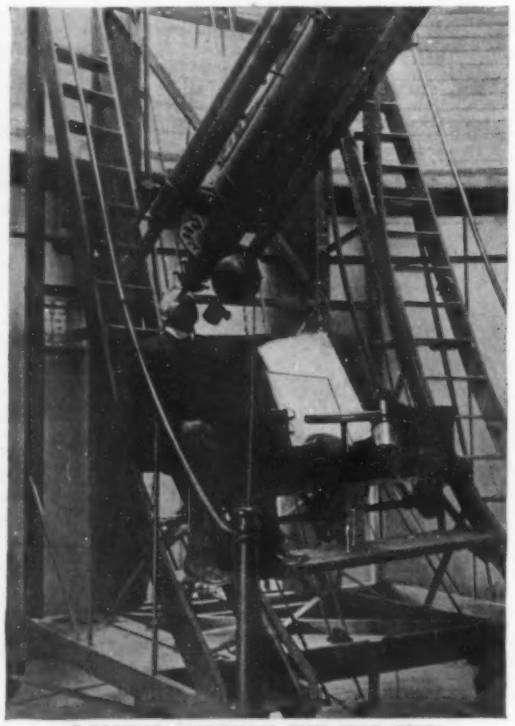
The spectrum of the star showed characteristics much like those of other novæ, but with much slower changes. While rising in brightness, it exhibited a dark-line spectrum, resembling that of a star of Class F—that is, with the lines of hydrogen, and the spark lines of the metals—due to ionized atoms which have lost an electron. Similar dark-line spectra were shown by several other new stars which were "caught on the rise."

As in these earlier cases, just as the light began to fade, the spectrum suddenly changed, showing wide, bright lines of hydrogen and other elements.

Presumably, as in other cases, the star will fade gradually and, in a decade or two, nearly resume the brightness which it had before the outburst—as Nova Aquilæ of 1918 has already done.

The appearance of this bright, new star makes a total of five which have been conspicuous to the unaided eye during the first quarter of the Twentieth Century—the other four being the novæ in Perseus, Gemini, Aquila and Cygnus. Only two such objects of comparable brightness were recorded between 1850 and 1900; but, considering the way in which they keep on appearing at the present time, it seems probable that the records in older days were incomplete and that these brilliant objects actually appear at the rate of at least a dozen per century.

Of the distance of Nova Pictoris we have as yet no knowledge at all; but it is highly probable that, like the recent novæ, it is several hundred light years away and that, at its greater brightness, it was at least a thousand and probably ten thousand times more luminous than the sun. Before the catastrophe, when its light was some forty thousand times smaller, it may have been comparable with the sun, or fainter.



LOOKING THROUGH THE "BIG EYE"
Today, owing to the perfection of the telescopic camera, comparatively little direct observing is done

The great temporary star of 1918 displayed, for some three years subsequent to the flare-up, a small but steadily expanding nebula surrounding it. This expanding nebula showed, before the very eyes of the observers, that a mass of matter had been flying violently off from the star's surface in all directions, in quantities great enough to form a shell which was still visible after three years' expansion. The spectroscopic observation showed, at the same time, that the material of the nebula was approaching us on the rear side and receding on the far side at the enormous rate of about 1,200 kilometers per second. The dark lines which appeared in the spectrum in the earlier stages showed that metallic vapors were also present in the huge expanding shell, accompanying the permanent gases which alone shone later when the shell became a nebula.

Similar great displacements of the spectral lines have been observed in other novæ, and it appears clear that, when the disturbance begins, the star starts to expand with enormous speed. At first the surface seems still to shine like a solid body and the atmosphere above it absorbs its light, giving rise to a dark-line spectrum, with the lines strongly shifted by the motion. Later the gases appear, as it were, to get free—probably by expanding so much that they become transparent—and the spectrum changes to one of bright lines or, rather, bright bands, enormously widened by the shifts due to the rapid motions of different parts of the gaseous envelope, some moving toward us, some away from us—and, just at this time, the net brightness of the star, which had previously been increasing, begins to fall. What little we know of Nova Pictoris fits in well with the belief that this type of violent expansion of the star has occurred in this case, too.

This extraordinary expansion is evidently caused by some huge explosive liberation of energy at the star's surface, or a little inside it, which drives the outer portions outward at such a rate that, in a day or two, they get practically beyond the influence of the star's attraction, and fly off into space, straight outward in all directions. Since the star remains after the ejected matter has spread out so far that we lose sight of it, and remains with almost the same brightness as before, it seems clear that the outburst, vast as it is, must be only superficial, leaving the main core of the star untouched.

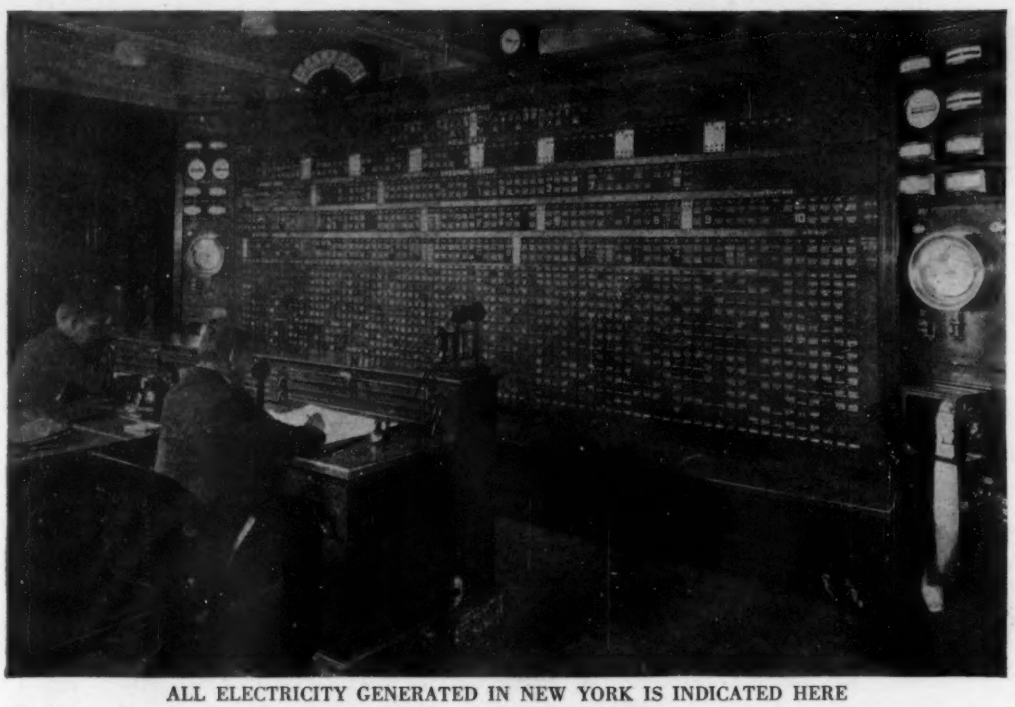
A Sun in Conflagration

On the existing evidence, it appears very probable that the general explanation of the phenomena will turn out to be sound; but many details remain puzzling—not the least of them being how a star like Nova Pictoris can continue shining, thousands of times more brightly than normal, for three months without altering in brightness during this time by more than five or six-fold.

What causes the tremendous explosion is still very much a mystery. The amount of energy liberated must be so great that it is tempting to suppose that, in some way, the energy locked up in the core of the atoms—which as we said last month, is probably very slowly liberated in the deep interior of an ordinary star—is here rapidly liberated.

Any process which led to an intense local heating of the stellar material, for example, the infall of some body—even a small one—from the outside, might set off such a conflagration.

It is rather startling, however, to realize that such an event may have happened, at some time in their lives, to most stars. During the past twenty-five years, three great novæ have appeared, which were previously visible stars of the 10th to the 14th magnitudes. The whole number of stars brighter than the 14th magnitude is about twelve millions. If only twelve of these stars suffer these catastrophes in a century—as the recent record suggests—the average star should blow up once in a hundred million years or so. It may be that this estimate—which is obviously very rough—overstates the case. The sun has certainly suffered no such catastrophe during geological time—that is, in the last billion years or so. But, even if a star blows up on the average of only once in ten billion years—which is straining things the other way—and, if the life of a star lasts for many thousands of billions, as the evidence we discussed last month strongly indicates—it looks as if the average star must have gone through not one only, but dozens of such outbursts.



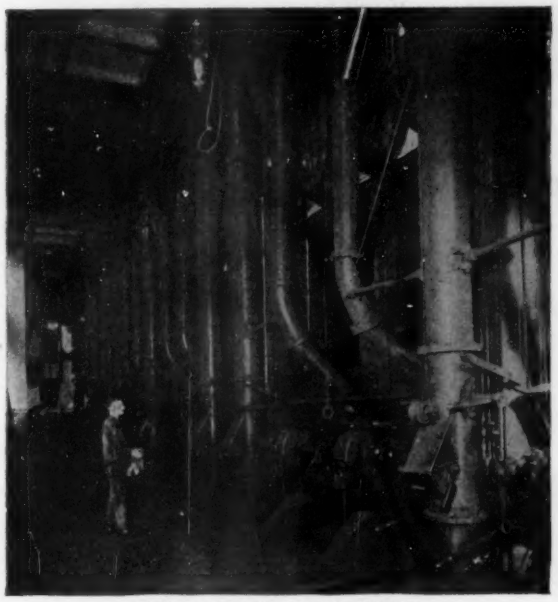
ALL ELECTRICITY GENERATED IN NEW YORK IS INDICATED HERE

The System Operator's board at the Waterside Station of the New York Edison Company where the current produced by the power houses in the interlocking system is visualized

Controlling a Million Horsepower

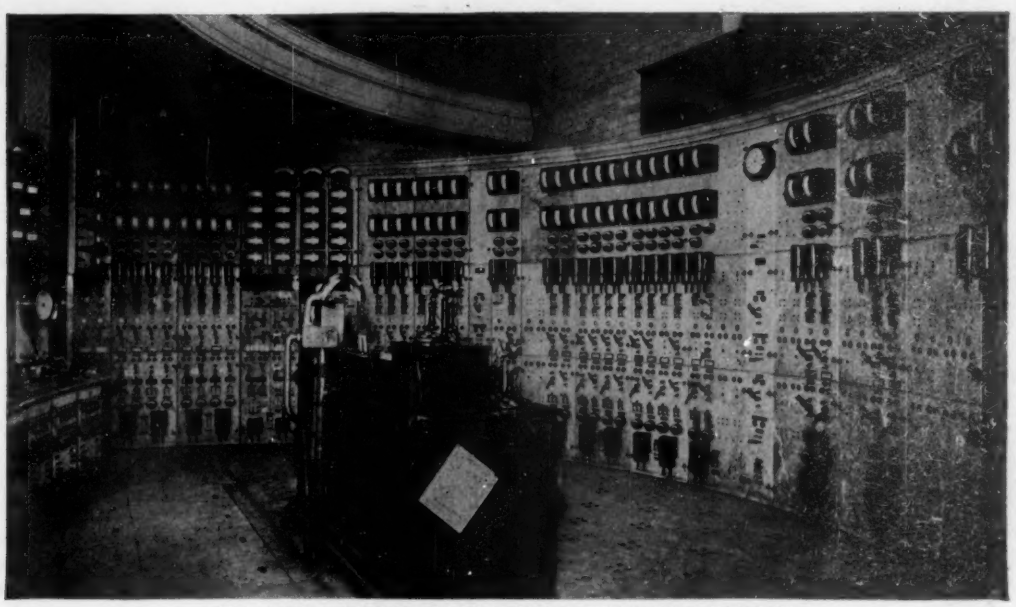
One of the most spectacular sights in connection with New York's electric generating system is the room where all the great power houses are tied together so that the current can be transferred from one to the other at will. This unifies the service, prevents interruptions and makes for economy. We show how this is done in several steps.

The "System Operator" sits at a desk and watches a huge board where signals flash and change according to his orders. His duty is to adjust the supply of electricity to meet ever-changing demands. Coming events cast their shadows and this man must see the shadow coming before anybody else. He speaks in terms of boilers. A storm approaches, a signal is given, a whistle blows in the boiler room and Waterside "blows in" sixteen more of her one hundred and forty-six boilers. The operator has under his control a total rated capacity of 1,061,000 horsepower. Two of the other illustrations show the great switchboards at Waterside and Hell Gate stations where his orders are carried out, and another shows a boiler room.



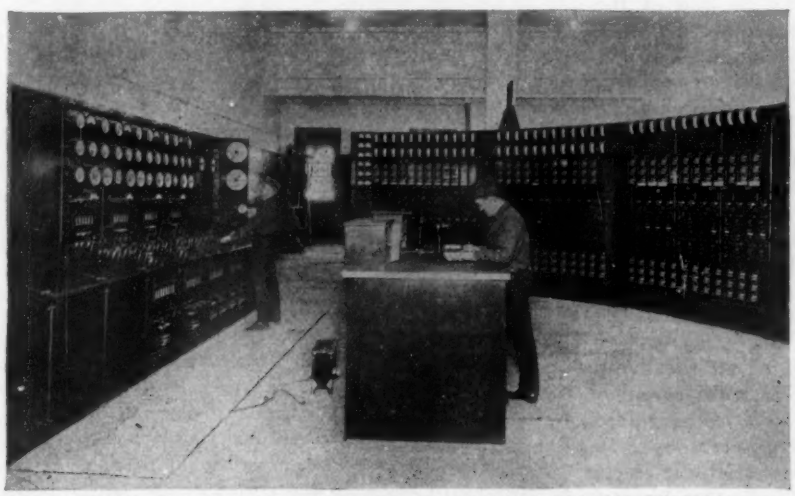
SOME OF THE 146 BOILERS

The boilers are fed by mechanical stokers using powdered coal. Steam whistles are used to signal the men in charge



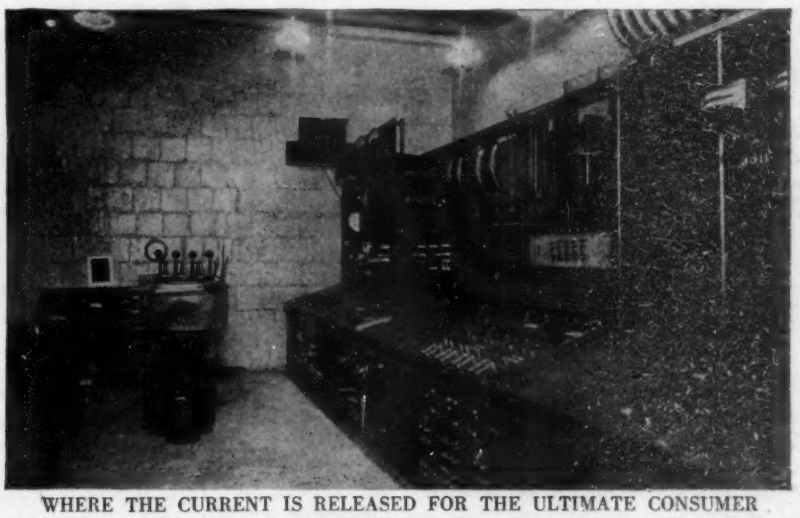
THE GREAT SWITCH ROOM OF THE WATERSIDE STATION

The orders from the System Operator are executed here. This vast switchboard controls the output of one station and allows for connection with others. Two men are usually sufficient to operate it



CONTROLLING THE HELL GATE GENERATING PLANT'S OUTPUT

Main operating room at the Hell Gate plant from whence the huge switches are remotely controlled in other parts of the building. Two men only are required to operate the switching of this powerful unit of the system



WHERE THE CURRENT IS RELEASED FOR THE ULTIMATE CONSUMER

One of the substations where the pressure of the current is lowered by means of transformers and changed, when required, from alternating to direct. Everything is controlled by the System Operator from his board

No one's hair has ever turned pure white over night, says Dr. Hausman, who adds that accounts of sudden whitening are simply "old wives' tales"

Why Hair Turns Gray

A Study of the Developing Hair Through the Microscope Reveals the Secrets of Color Production and Color Loss

By Dr. Leon Augustus Hausman
Professor of Zoology, Rutgers University

THE hair of the human head, seen through the microscope, reveals itself as not merely a thin, elastic rod of homogeneous appearance, but as a complex structure, the product of the growth of innumerable cells from the surface layer of the skin, or epidermis. If we imagine a portion of a hair, enormously magnified and cut in various planes, we would find that its structural elements stand out quite clearly.

Through the center of the hair extends an irregular column of closely compacted cells. This column or pith is called the *medulla*. Outside of that is a thick investiture of long, cigar-shaped, closely compacted cells, forming an almost transparent layer, the *cortex*. Outside of all, and covering the hair-shaft with a thin, transparent cuticle, lies the layer of *cuticular scales*. In the human hair these cuticular scales overlap, like the shingles on a roof, or the scales of a fish. All this hairshaft structure comes from the epidermis or outermost layer of the skin.

Hair the Product of the Epidermis

"How can that be," you say, "when we know that the hairs grow up out of little pits that start *beneath* the outer skin?" Look at our illustration showing how a hair grows. Notice the comparatively thin outside layer or epidermis, of the skin. See how it bends down into the thicker true skin or dermis which lies beneath the outer skin and forms that little pimple-like projection at the bottom, which looks as if it were being grasped by the lower end of the hair. This pimple-like projection is the papilla, and it is from this that the hair takes its origin. So, after all, you see, the hair is really a true product of the outermost layer of our skin.

What has all this to do with hair color and hair grayness? Just this: a hair begins its growth in the following manner: first, the cells in a certain spot in the epidermis begin to multiply rapidly and, as they multiply, they push downward into the soft true skin or dermis until they have formed a little flask-shaped depression. In the base of this depression grows the little hair papilla already referred to. It is the regular multiplication of the cells that cover and lie round about this little papilla that produces the hair. Of course, as these cells multiply, a long, cylindrical mass of them is pushing continuously upward and outward. This is the hair itself. The flask-shaped depression is called the hair follicle.

What Hair Color Is Due to

The important thing to keep in mind is, that it is the multiplication of the cells around and about the papilla that produces the hair with its three parts: the medulla (pith), cortex, and cuticle (outer layer).

The color of the hair is due to materials deposited in its cortex layer. These materials, which we call pigments, are produced, of course, by the same cells that go to make up the cortex of the hair. This color may be modified by the condition of the medulla, that is, whether the medulla is present or absent, thick or thin, and so on. Moreover, the

Is There a True Science of Hair?

Commerce has been forced for some years to seek the aid of science for its fundamental fur facts. Only the scientist with his microscope can determine the true nature of a pelt, for the hair of every mammal has its own distinctive earmarks. In the accompanying article one of the scientists who has worked out the science of hair tells us why hair turns gray.

Dr. Hausman is a professor of zoology. He has devoted years to comprehensive research on hair. He has been called in as consulting expert by great scientific institutions, such as the United States National Museum, The American Museum of Natural History and the National Museum of Argentina. Recently he acted as advisor to the State College of Washington in the interesting case of the "Washington Couger Tragedy."

Hair from the heads of all the living races of man, as well as from some of the prehistoric races, have come under Dr. Hausman's inquisitive microscope. In this article he presents scientific facts which the reader may judge for himself why hair turns gray.

pigment materials may be in the form of a diffuse stain, coloring the cortex uniformly and homogeneously; or, as is more often the case, they may be in the form of separate granules. In "red" hair, the coloring material is in the form of a diffuse stain. In the brown varieties of hair, and in black hair, the color is granular. The way in which these little coloring granules differ in shape, size and patterns of arrangement in the hairs of the various races of mankind, forms a very interesting study; but it is one which has little bearing on our inquiry concerning the cause of gray hair.

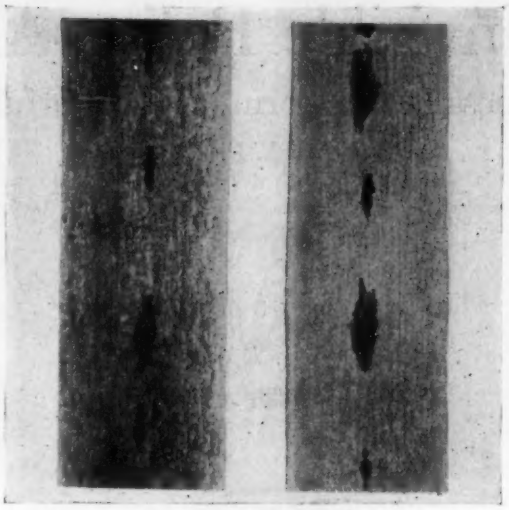
If you look at the accompanying photographs of highly magnified portions of hairs from the human head, you will see that the hair on the left—which in this case happens to be brown—with its full quota of pigment, is filled with little flecks and granules of the coloring substance; while the gray hair on the right contains very few, or none, of these granules. In pure white hair no pigment at all can be found in the cortex of the shaft.

Now we know why it is that hair turns gray. It is because of the failure of the little cells which form the cortex of the hair down in the base of the hair follicle and around the papilla to deposit pigment material.

Hair a Dead Structure

Why do these little cells stop depositing this material? That is what we do not know. In general, of course, we can say that after a while, either through disease, malnutrition, old age or similar causes, the hair cells become less and less active. Often, in fact, the very first indication of our loss of early vigor is the failure of these cells to make any more coloring matter. Thus, we might say, the papillal cells send up out of the mouth of the follicle a hair which, in a sense, is only partly completed. That is, the cells are beginning to weaken. They have done all they can to produce a hair. They simply cannot make more coloring matter for it. They can just about build the structure; they cannot paint it too.

Since you know that a hair grows from its base, very much like a finger-nail, you will not be surprised to learn that after the hair leaves its papilla, or at least, after it emerges from the mouth of the follicle and above the surface of the skin, it is practically *a dead structure*. This is an important thing to remember. The hair's only connection with the body is that it is rooted in the scalp. It has no organic connection with the body. Neither nerves nor blood vessels run up into it.



WHY A HAIR TURNS GRAY

Under the microscope a brown split hair shows pigment granules as in the picture on the left. When these granules are absent the hair becomes pure white (right). When they are present in small numbers the hair is grayish

What is the significance of this fact? It means that no changes can go on in the hair after it leaves the surface of the skin, other than such artificial changes as, for example, drying, cutting, dyeing, and so on. Thus, after it has grown out beyond the surface of the skin, the hair cannot change its color any more than the outer garments which you wear can change their color.

However, hair does turn white gradually, for the cells that are constantly working at the base of the follicle, and are constantly pushing out a greater and greater length of hair, may stop manufacturing coloring matter. In such an event the hair that is growing out keeps getting lighter and lighter, until finally, when the coloring deposit stops altogether, it will come out pure white.

But no one's hair has ever turned a pure white over night and never can—unless it is treated with a decolorizer. The tale of hair whitening over night is a hard story to down; but down it we must, along with the stories about spontaneous generation of eels from mud, fire-spouting dragons, and the like.

The little cells which produce the hair go on multiplying and pushing out the hair shaft day and night, month after month, until finally the papilla withers away, the hair stops growing, and it must therefore wait for a new papilla to form. Now this happens in all hair follicles. A new papilla soon forms and the hair-production is resumed.

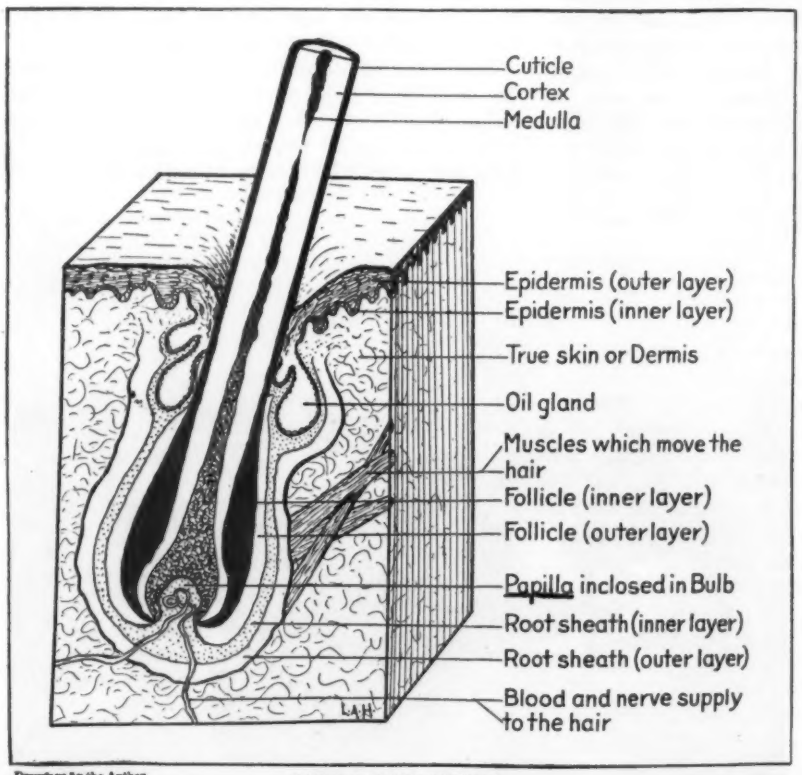
Life of a Hair Six Months

How long is the natural life of a hair in the human scalp? The average life of a hair in the scalp, that is to say, the period during which there is uninterrupted multiplication of the papillal cells, is said to be between five and six months. There comes a time, finally, when the new papilla refuses to form, and thereafter no hair emerges from the follicle. When there is no further activity of the papillal cells it follows that there is no hair.

What can we do to prevent the graying of hair? We should correct the failure of certain little groups of cells in the bases of our hair follicles to produce pigment materials. How? Ah, there is the question! I am sure I cannot answer it.

One thing is certain. We must keep these little cells alive and vigorous. I believe we can do this, not by the applications of things from *without*, but by the natural, physiological approach to these cells from *within*. I mean that it can only be done through the blood vessels which nourish the papilla, bring it food, oxygen and water and which remove its wastes.

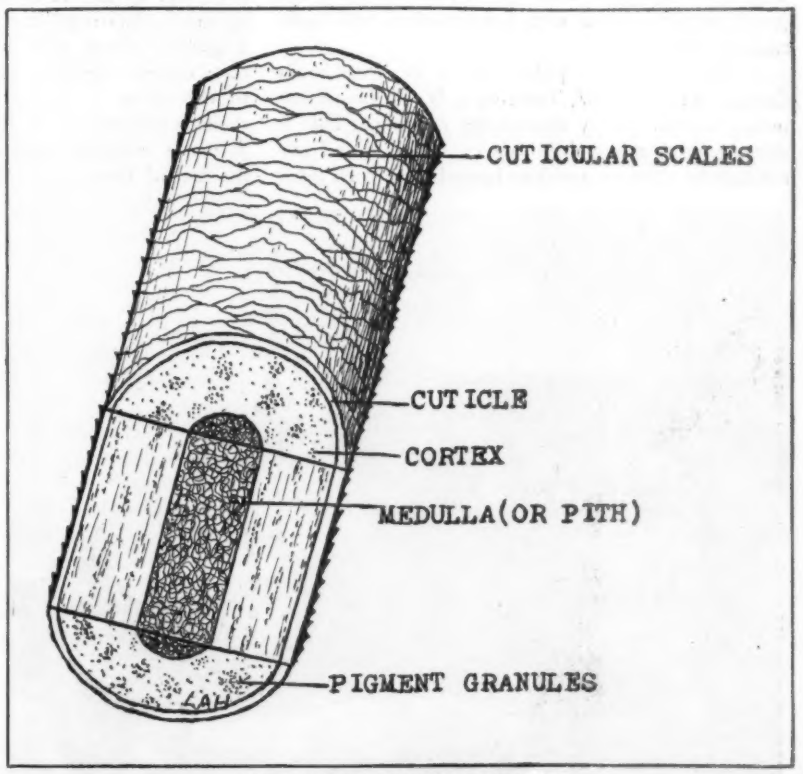
This kind of treatment applies equally well to keeping all of the hair cells alive. If we can do this too, then we can prevent not only grayness but baldness as well.



Drawings by the Author

HOW A HAIR GROWS

This drawing shows a section through the human scalp, cutting a growing hair. The hair is produced by the rapid multiplication of the cells covering the papilla, and around its base, thus pushing the hair upwards and outwards



HOW A HUMAN HAIR IS BUILT

A highly magnified section of a hair from the human head, partly cross-sectioned. The coloring matter is located within the cortex, or medulla, or both, either as a diffuse stain or in the form of separate granules

An Invisible Police Alarm

Radio Is Proving Its Usefulness in the Form of a Powerful Weapon Against Criminals

By Orrin E. Dunlap, Jr.

RADIO is recognized by police officials throughout the world as a new and extremely valuable weapon for the suppression of crime and for apprehending criminals, because of the speedy communication the invisible waves afford. Electromagnetic impulses released into space at the speed of sunlight, 186,000 miles a second, spread a far-reaching alarm, which has no equal so far as area covered, number of persons informed and speed are concerned. A law-breaker can travel only a short distance from the scene of the crime before the etherial alarm has spread a net around him at bridges and cross-roads, along main highways and waterfronts, at railroad stations and all other exits through which he might make his escape.

Scotland Yard Uses Radio

Radio is said to be revolutionizing the methods of Scotland Yard, the famous headquarters of London's police. Experiments there have revealed radio so widely useful in police work that a dispatch from England claims that the entire system of crime detection throughout the British Isles is likely to be shifted to a radio basis. The Yard has seven radio-equipped motor cars attached to the Criminal Investigation flying squad. Each car carries a 200-watt transmitter with a voice range of 30 miles and a wireless telegraph radius of 200 miles.

These radio cars not only aid in detecting crime but they perform a helpful service in regulating heavy traffic along the highways. On Derby Day they were stationed at strategic points on the roads leading to Epsom and by signaling to each other the moment traffic was to be diverted, they prevented the arteries of transportation from being choked with automobiles. It is believed that before long, detectives engaged in work which requires quick and secret communication with headquarters, will carry small portable sets.

At the request of police chiefs in Westchester County, station WRW, Tarrytown, N. Y., broadcasts police alarms hourly during the evening. This is done to catch automobile thieves, burglars and motorists who after an accident immediately dash away from the scene. It is understood that each police station in the county will have a special receiver and a general alarm will be radiated each evening at nine, ten and eleven o'clock. Listeners will be asked to cooperate by notifying patrolmen on beats in their neighborhood of the messages they intercept. A small one-tube receiver is being developed for the use of motorcycle policemen so that they also can tune in on the alarms at the specified hours.

NEW YORK'S MUNICIPAL RADIO STATION

From the aerial held aloft by the Municipal Building an invisible alarm is carried to police precincts and booths in the metropolitan area

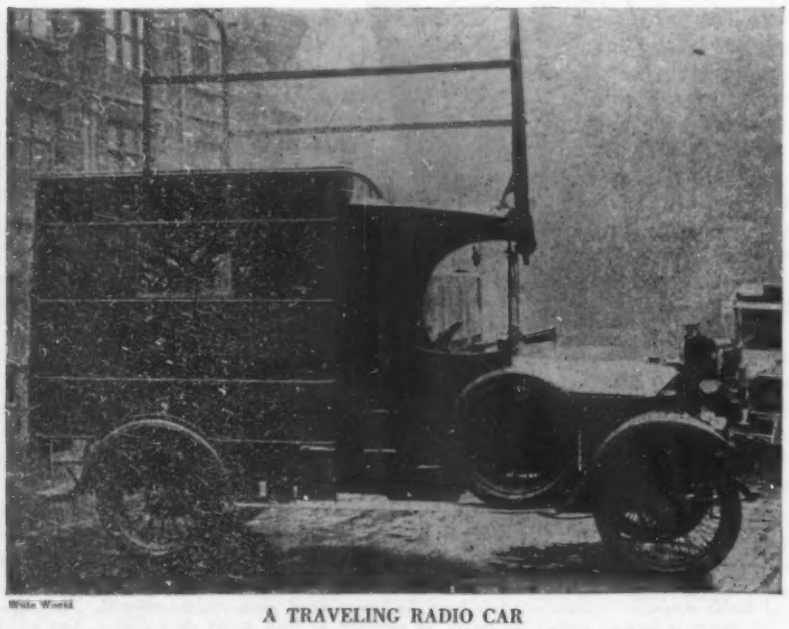
The Detroit Police Department has its own broadcasting station recognized in the ether by the appropriate call letters "KOP," and now New York has announced its plans for a police radio system, which it is claimed, will be second to none in the world.

This new, city-wide, radio-alarm system will enable Police Headquarters to reach simultaneously every police station or precinct in the New York District. A characteristic radio signal, broadcast from the aerial of the municipal radiophone station WNYC, atop the Municipal Building, when detected by a police receiver, causes a sentinel light to glow on the panel of the set. There are two lights, red and green. The red light is the alarm to signal the officer on duty to don the headset and listen. The green appears constantly when the power is on as an indication that the set is operating properly. If desired, the circuit can be arranged to ring a gong instead of lighting the red electric lamp. This system of visual signals, or the bell, dispenses with the necessity of having an operator constantly on watch wearing a headset.

Constantly in Tune with WNYC

The transmitter control at Police Headquarters is a slow acting relay, which automatically calls the desired police station. An individual station house may be called, or all stations in a certain borough, or every station throughout the city. There are six small levers on the transmitter control, calibrated in letters and numbers. The letters represent various boroughs and the numbers the stations. The levers move up and down in slots with several stops, each lettered or numbered. The levers are set at a combination of letters and figures, which forms the name or call of a certain police station. The group of dots and dashes, with definite pauses between, is then automatically sent into the ether by WNYC, directly coupled with the lever device.

The operation of calling each station resembles that used by a train dispatcher when he calls the various tower men along his line. The levers are arranged in a small box on the sending operator's desk and, when a call is to be made, they are set



Wide World

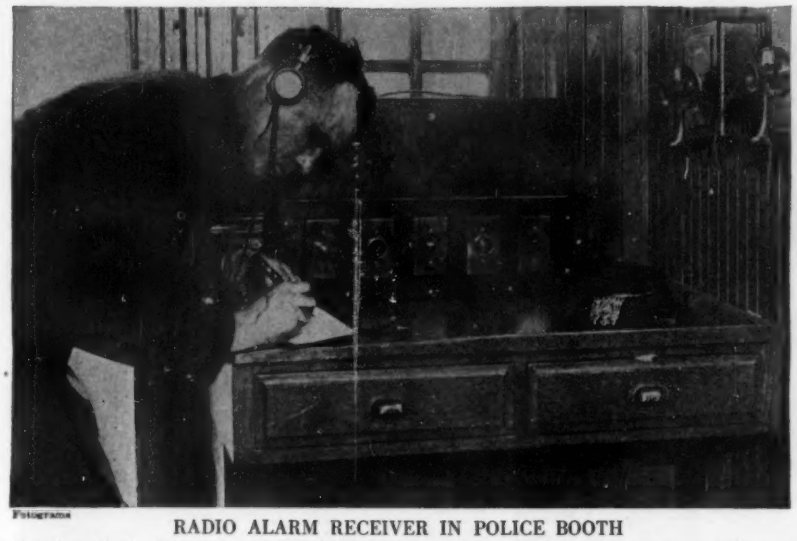
A TRAVELING RADIO CAR

A car completely fitted with radio equipment is used by Scotland Yard officials

Brown Brothers

RADIO PLAYS THE DETECTIVE

New York State Police stage an arrest with the aid of radio



Fotogrammi

RADIO ALARM RECEIVER IN POLICE BOOTH

The New York Police Department plans to have booths at bridges and along the highways equipped with radio sets, so that simultaneous warning may be given, thereby stopping criminals or suppressing riots

Kadel and Herbert

POLICE RECEIVER IN A BROOKLYN STATION HOUSE

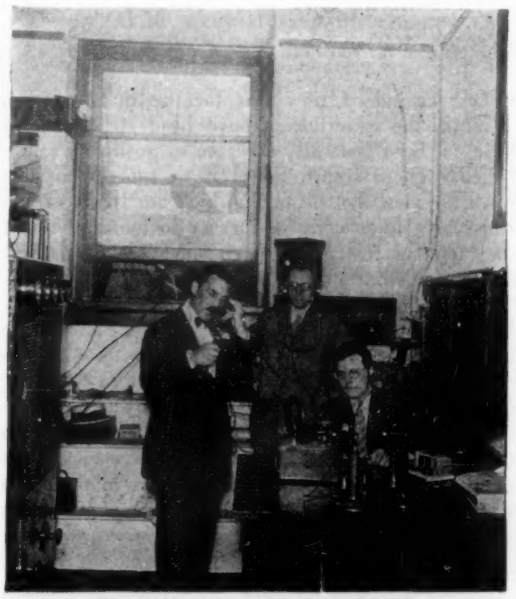
A red light on the panel warns the officer on duty to don the headset and listen to WNYC, broadcasting direct from Police Headquarters. A green light indicates that the apparatus is in proper working order

to the number of the station wanted. As soon as these levers are in the proper position a corresponding number of pulses of 3,000-cycle alternating current are sent into the broadcast transmitter. This modulates the radio carrier current, like other frequencies in the audible range, and any listener tuned-in on WNYC's wave hears at intervals a series of high-pitched tones, which means that the police alarm is on the air.

The entire system is easily operated. The special relay with a permalloy magnetic circuit is the first to function. When the transmitter current is modulated by the 3,000-cycle tone, in accordance with the impulses of the selector key, the plate current of the rectifier tube is increased to an amount sufficient to operate the relay. The alternate operation and release of this relay automatically closes a circuit intermittently. This brings about the operation of the other relays in succession, thereby stepping the contacts of the selector around until they are in the proper position to complete the local alarm circuit. The selector is capable of responding to any of 253 code calls.

The receiving equipment is of special design having been developed by engineers of the Western Electric Company. It does not resemble the ordinary broadcast receiver. Each set will respond to three combinations of intermittent sounds: one, the call of the individual station; another to the group of stations to which it belongs, and the third, to the general call for all stations.

The receivers are of comparatively simple type, built in a portable case about the size of the ordinary suitcase. No tuning adjustment is accessible because the circuits are designed for use at one frequency, or wavelength, and all necessary adjustments are made within the cabinet at the time of installation. It is then locked. Therefore, all receiving stations are in tune with WNYC at all times. The exterior of the panel shows only a jack for the plug of the headset cord, the red signal lamp and green lamp with associated switches.



TRANSMITTER ROOM OF WNYC

By means of this broadcasting apparatus police alarms can automatically be put on the air

The complete equipment at the police receiving stations includes the receiver, four vacuum tubes, sensitive relays, a modified form of Western Electric train dispatching selector and a signaling device, either light or bell. Engineers point out that one important feature of this set is the use of the relay, the magnetic circuit of which is made of permalloy, a new alloy recently developed in the Bell Laboratories and first used commercially in the New York-Azores cable.

The receiving circuit requires no batteries. It is arranged to operate on a 110-volt direct current or alternating current supply. The system may be used with either current with equal efficiency.

When in normal adjustment, the police receiver will detect the regular programs of entertainment broadcast by WNYC. But when the alarm signal is sent all other broadcasting by the municipal station stops. The proper code impulses are then transmitted and the called station or stations are summoned by their red light or bell. When the call is answered, the operator disconnects the light or gong by pressing a button.

Police officials call attention to the fact that in order to capture criminals immediately after a crime has been committed, it is essential that every section of the city be notified quickly. The practice of the past has been to spread such alarms by land telephones, connecting headquarters with all precincts. This system requires time, because each station house has to be called individually. The plan is to have the radio system supplement all existing wire communication channels, operated by the police.

The police department plans to have 200 receiving sets in use within the next year. The cost of installation is estimated to be $50,000.

Police Commissioner Richard E. Enright said, "I believe this is the greatest advance that has been made in the application of radio to police work. The New York installation will undoubtedly result in widespread use of a system of this type throughout the world. With a device like this, where the information can be immediately flashed to all of the strategical points of the city and to zones where we can enclose the criminal and get immediate action, we are going to be able to deal far more efficiently with criminals than we have been heretofore."

Fotogramma

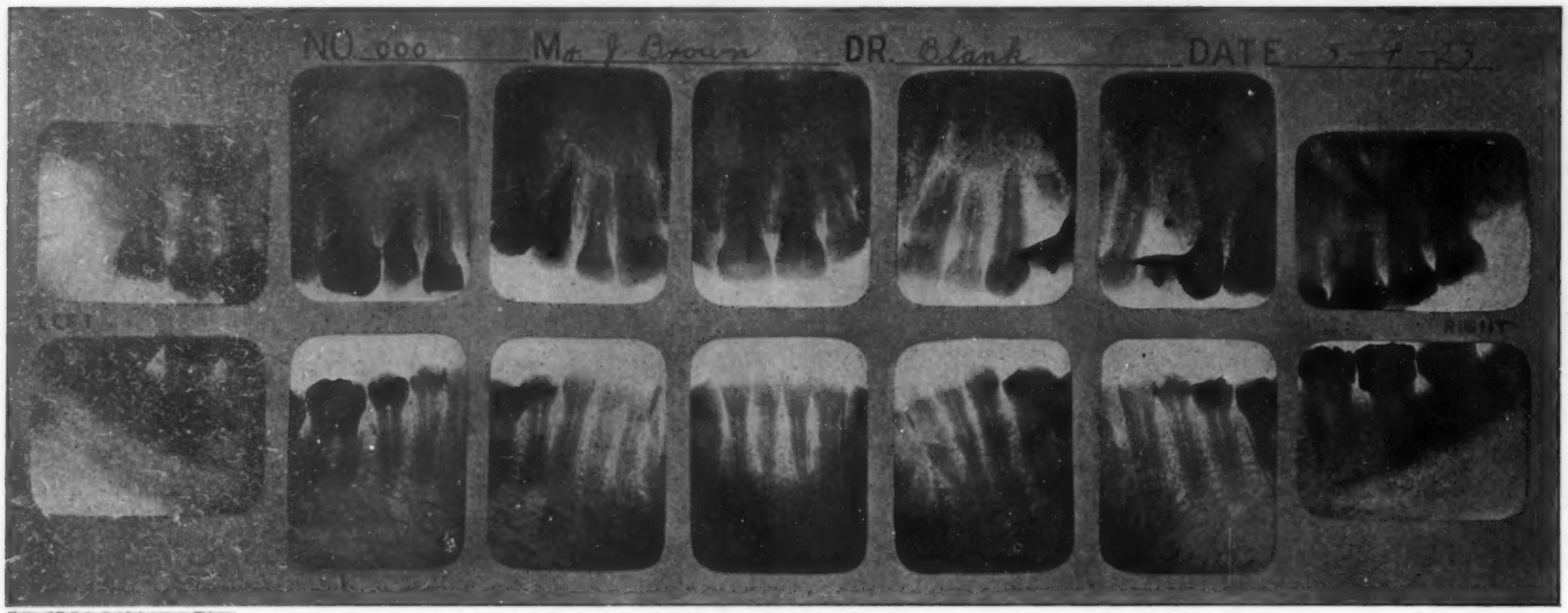
SIGNALING APPARATUS AT HEADQUARTERS

The device consists of six levers movable in slots, set to a combination of letters and numbers which forms the signal

Fotogramma

INSIDE CONTROL PANEL OF THE RECEIVER

The circuit is tuned to respond to a certain wavelength so that the operator is always in tune with WNYC



National Pathological Laboratory, Chicago

By changes in the density of the tissue at the roots of the teeth, as shown in this dental X-ray plate, focal infection is diagnosed

The Progress of Medical Science—II

The Discovery of Insulin and the New Ductless Gland Therapy

By Morris Fishbein, M.D.

Editor, Journal of the American Medical Association, and of Hygeia

ONE of the most significant steps in modern medical science has been the new emphasis laid on the doctrine of "focal infection" and its relation to the origin of various disorders in the human body.

Stated simply, this doctrine implies that a chronic infection in the roots of the teeth, in the tonsils, in the nose and throat, or, in fact, anywhere in the body, may constitute a point from which germs are regularly carried by the blood to other portions of the body, where they set up new spots of infection, producing severe symptoms which continue until the original focus is removed. It has been known for years that infections of the lining of the heart might frequently follow infections in the throat, and it has been known also that chronic rheumatism, chorea, painful back and infections in the joints were frequently secondary to such foci of infection.

Once the idea was suggested and fairly well established, as is the case with many other phases of human life, it was carried to extremes by some of its advocates; in fact, to a point far beyond the belief in its merits of its original proponents. After a decade of experience, it has become firmly established as a principle, so that today no competent physician fails, in obscure cases, to make a complete search for such foci of infection and particularly so in the diseases which have been mentioned.

Have Bacteria Idiosyncrasies?

Closely allied to this work are experimental investigations as to the specificity of certain bacteria for producing certain lesions. The leader in such investigations has been Doctor E. C. Rosenow, of the Mayo Clinic. He has published experimental evidence to indicate that certain forms of bacteria, arising in foci of infection, tend to localize in certain organs, such as in the stomach in which they may produce ulcer; in the heart, where they cause inflammation of the inner lining, or of the valves; in the kidneys, where they cause the formation of pus or of kidney-stones; in the gall bladder in which they cause inflammation or become the nucleus of stones; or indeed, they may localize in any organ.

While the experiments have been striking, they have not been generally accepted as positively established. There seems, however, to come from this work the view that bacteria, which are living organisms, have idiosyncrasies just as do human beings; they tend to live in the environment which is best suited to them.

Typical of the advances made in biologic chemistry is the gradual growth of our knowledge of diabetes—a disease which is manifested by a derangement of the ability of the body to take care of carbohydrates or sugar. It was known many centuries ago that in this disease sugar is excreted in the urine. Some fifty years ago, German investigators found that when a patient dies in the coma or unconsciousness that is characteristic of death in this disease, there is overproduction in his system of acetone or diacetic acid; the body condition is that of acidosis.

Brown Bros.

DR. F. C. BANTING, DISCOVERER OF INSULIN

The regular use of insulin helps the diabetic to dispose of sugars within the body

Later, when the method of study of functions of organs was developed—which involves the removal of these organs and the observation of the effects which follow extirpation—it became apparent that diabetes could be produced by the removal of an organ lying close to the stomach and liver, and known as the pancreas. Another investigator showed by studies with the microscope that the pancreas contained a certain form of differentiated tissue in the shape of little islands, which have since been called the islands of Langerhans.

Continuing these studies, pathologists observed that in cases of diabetes, after death the islands of Langerhans were degenerated, and physiologists found that if the ducts leading from the pancreas were tied off, so that the digestive juice or secretion that comes from it was dammed back, the ordinary tissue of the pancreas would be digested and the islands of Langerhans would, to a great extent, remain intact.

Insulin Disposes of Sugar

With these studies before them, Doctors Banting and Best conceived the idea of preparing in this way an extract of the islands of Langerhans with which they could treat diabetes. Working with the advice of Doctor J. J. R. Macleod of Toronto, and aided in preparing the extract by Doctor J. B. Collip, they at last produced insulin, the culmination of the researches of a half century—researches made by hundreds of scientists in all of the medical laboratories of the world.

Insulin, given to diabetics, aids them in properly disposing of sugar within the body. But even without this artificial aid, scientists, who have made careful study of the chemistry of digestion, have been able to devise suitable diets which will maintain the life of the diabetic, controlling his intake of sugar and preventing him from passing into the condition in which there is too much sugar in his blood, which

condition is likely to result ultimately in his death.

Closely related to the diseases of metabolism are the diseases of the glands of internal secretion other than the pancreas; such glands as, for example, the pituitary, the thyroid, the adrenal and the so-called sex glands. With modern methods of study—involving the microscopic examination of the tissue before and after various procedures, the extirpation of the gland, the administration of the gland substance by mouth and in various other ways—scientists have been able to collect a vast amount of data concerning each of these glands and its relation to others.

Glands Are Factors of Safety

It has become clear that the glands are related in function, and the body possesses here, as in other cases, factors of safety, so that one gland may take up a portion of the work of another gland which may be incapacitated. However, conditions do arise, as by the growth of tumors, or through congenital absence of portions of a gland or deficiencies in its work, whereby the functions may be greatly increased in some cases, or be wholly absent. In such cases, diseases such as giantism, obesity, dwarfism, cretinism with idiocy, and many other unusual malformations of the body may follow.

Doctor J. B. Collip, subsequent to his work on insulin, has been able to derive from the parathyroid glands in the throat, lying close to the greater thyroid gland which is involved in goiter, an active substance, which bids fair to be of great importance in the treatment of disease. This parathyroid hormone profoundly influences the amount of calcium in the blood.

Calcium is a chemical substance involved in the building of bones and teeth and apparently has an important influence on nerve irritability. It has been given with benefit in such conditions as asthma and hay-fever. It seems to have some relation to spasmodic seizures such as occur in tetany and in epilepsy. Extension of Collip's investigations by clinicians may show great value in the use of the substance which he has isolated in such diseases as these. Moreover Doctors Allen and Doisy, working in the University of Missouri, have found a substance within the ovary, immediately after it has developed an ovum or female egg cell, which may contain the active substance of that gland.

Here is a vast field of knowledge already learned; but it is obvious that even this is to be considered only as an indication of the tremendous amount which remains to be learned.

In the abdominal cavity, on the left side, under

© Lederle Antitoxin Laboratories

THE SKIN SENSITIZATION TEST

The arm is inoculated with extracts of substances thought to cause asthma or hay fever

the edge of the ribs, lies an organ known as the spleen, a large mass of tissue, different in structure from other tissues within the body. The purpose for which this organ was placed in the body is not definitely known. It is believed to have a relation both to the formation of blood cells and to the disintegration and disposal of damaged blood cells. It has been alleged that it has an internal secretion, but thus far nothing positive has been established.

The causes of pernicious anemia; of lymphatic leukemia, a disease characterized by a persistent increase of the white blood cells; of Hodgkin's disease, in which the white blood cells increase and tumors of lymph glands form; of hemophilia, in which there is a tendency to bleed and in which the blood does not seem to coagulate properly, are not yet known. The causes of these diseases may be found perhaps in some disorder of an organ whose functions are not yet completely or clearly understood or in some disorder of the entire body chemistry not yet ascertained.

There exist also certain conditions related to the nervous system, such as epilepsy and persistent forms of headache known as migraine, which seem to have their basis in deep-seated disturbances of the body chemistry not yet worked out. Then, too, forms of degeneration of the tissues of the nervous system, such as occur in paralysis agitans or the shaking palsy, and in various forms of progressive paralysis, have not yielded to scientific investigation.

When the serious forms of mental disease, such as dementia praecox and other forms of insanity whose origins are unknown, are added to the list of diseases of unknown causation, it becomes apparent what a vast field still lies open to the student of medical science.

How Immunity is Developed

Experimental studies have shown that certain persons are likely to develop asthmatic attacks or hay-fever following the ingestion or inhaling of very small amounts of foreign protein substances. In diagnosing such conditions, the scientist makes extracts, in minute doses, of the protein substance to which the person is supposed to be especially susceptible, and makes skin tests on the patient's arm with a simple solution of salt or water for a control of the test. If the person is especially sensitive, the point of inoculation develops a reaction, with an area of redness and slight swelling. It is then possible, in some instances, to desensitize the person affected, by injecting at regular intervals a gradually increasing dose of the substance to which he is susceptible. The patient's body is thus enabled to build up resistance to the offending substance.

Carrying such studies even further, scientists have been able to show that extracts of certain bacteria may produce the sensitivity reactions, and that the taking of such bacteria into the body results in severe attacks. Obviously, the next step—and scientific studies have already been published along this line—is to determine the exact chemical substances responsible, and to work with fixed substances, rather than with extracts of unknown composition.

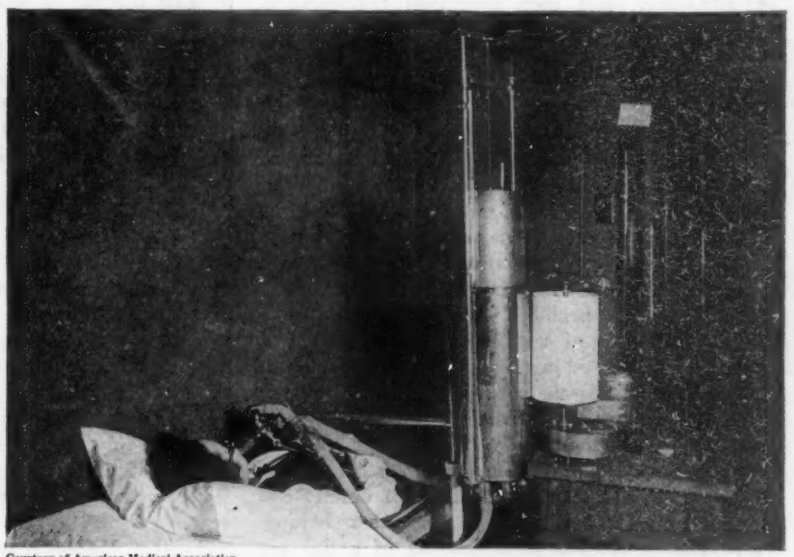
By studying the changes which occur in the body when a foreign protein is injected, physicians have learned that the response of the body is in the form of a general reaction, including fever, an increased number of white blood cells and other phenomena characteristic of the attempt to get rid of disease. Cautious attempts are now being made to utilize this method in stirring up the body, which is dormantly subject to some chronic disorder, to throw itself into the attack.

¶ In the third of this series of articles by Dr. Fishbein the subject of vitamins will be treated and the methods by which physicians diagnose disease will receive attention.

Wide World

GIANTISM, DWARFISH AND OBESITY

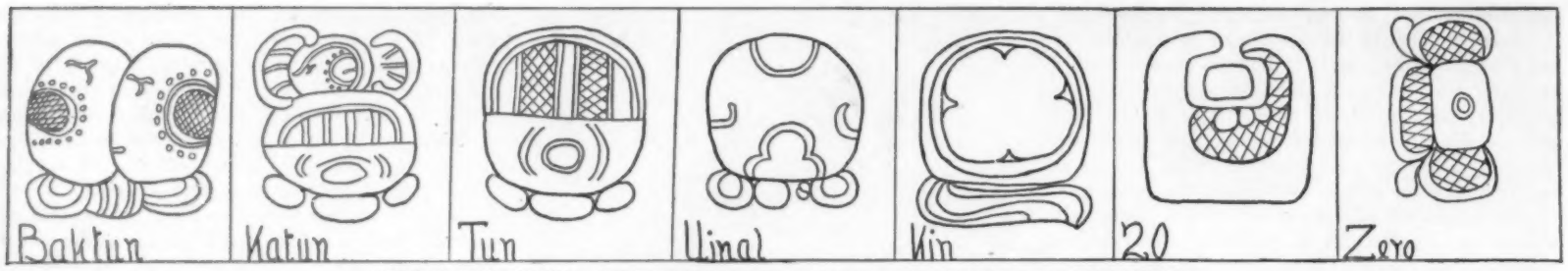
These abnormalities result from disturbance of the functions of the glands



Courtesy of American Medical Association

TESTING THE BASAL METABOLISM

Metabolism is the sum of the chemical changes within the body



PERIOD GLYPHS USED BY THE MAYAS IN MAKING ASTRONOMICAL CALCULATIONS

Reading from the right, the first two signs are the conventional signs for zero and twenty, and are placed next the others merely for convenience in magazine make-up. The next, Kin, corresponds loosely to our "units" position sign; "Uinal" corresponds to our "tens" position; "Tun," to "hundreds"; "Katun" to "thousands"; "Baktun" to "tens-of-thousands." As they used a vigesimal system, instead of our decimal system, these correspondences are only explicatory

The Amazingly Accurate Calendar System of the Maya Indians

With the Aid of a Remarkable Mathematical System These Early Americans Determined the Equinoxes and Closely Predicted Eclipses of the Sun and Moon

By James C. Bardin

School of Romanic Languages, University of Virginia

Line Drawings by Sally N. Bardin

NOWHERE on earth are the difficulties involved in keeping the day-count or calendar brought home to us so forcibly as in the southeastern part of Mexico and the eastern lowlands of Guatemala. In this part of America there developed in ancient times a civilization that we call Mayan. No one knows where it began, nor when. But we are reasonably certain that it had reached a high degree of development at least five centuries before Christ, and we know that it was flourishing brilliantly about 200 years after Christ. It continued, with alternating periods of decadence and renaissance, until about the year 1451, when it rapidly began to decay, a prey to severe internal disorders. Before there was opportunity for another renaissance, the Spaniards arrived and put an end to it forever.

Recent discoveries in the field of Maya archeology have confirmed the belief long held by students that the Maya Indians of Mexico and Guatemala solved the problem of time keeping and calendar making far more successfully than it was solved by any other people of ancient America. The Maya scientists, who flourished before and during the early part of the Christian era, had a profound knowledge of astronomy, and they developed mathematical methods of extraordinary accuracy for calculating the courses of the heavenly bodies and the time relationships of their movements.

.2422 of a Day Causes Trouble

When archeologists began a systematic study of the Maya hieroglyphics in the ceremonial centers of the cities of Guatemala, it was discovered that the careful keeping track of time was, perhaps, the most important intellectual problem faced by the men who built up the Mayan civilization.

The great time problem with which ancient man struggled was that of securing an accurate count of the number of days in a year. This is a difficult thing to do, because the earth does not complete an annual revolution around the sun in a rounded-off number of days; the time consumed being 365.2422 days. Any calendar, therefore, which is constructed on the theory that the year consists of exactly 365 days, or even 365¼ days, is inaccurate, because every year there will be a fraction of a day unaccounted for, and this has to be compensated for in some other manner.

Indian Intelligence as Good as Ours?

"The greatest intellectual achievement of ancient America," is what Dr. Sylvanus Griswold Morley of the Carnegie Institution says about the calendar of the Maya Indians of Central America.

Whether the grasp of astronomical science—no lesser word than science does justice—proved by their remarkably precise understanding of the motions of the earth and moon was simply that of the mind of the American Indian, or whether outside ethnological influences were contributed, remains to be proved and light will probably be thrown on this problem by the ten-year task of excavation now being begun by the Carnegie Institution.

The calendar-keepers of Chichen Itzá knew what they were about, and knew it very exactly.

Like our own ancestors, they too had found that the earth does not make an even number of revolutions on its own axis during its annual revolution around the sun.

Not only that, but they worked out a decidedly ingenious method of making allowance for the left-over fraction of .2422 of one day so that their calendar would remain stationary.

It is obvious that if we assume that a year has 365 days, there will be an annual excess of .2422 of a day. In four years there will be a total excess of about but not quite one day. If the calendar is to remain accurate some sort of correction is necessary to take up, or at least compensate for, this excess. Two methods suggest themselves. One is, to add one day to every fourth year. Such a calendar will, for the reasons just mentioned, gradually get out of adjustment, and the equinox will draw slowly nearer to the date chosen as the first of the year.

Another method is to fix a calendar year of 365 days, allowing the equinox to advance approximately one day every four years, and then calculate what calendar date will correspond to the spring equinox in any future year. The calendar we now use is based on the first method, but the Mayas used the second method. They considered a year to be 365 days in length, for practical purposes, and they did not make any intercalations in order to keep the calendar date of the equinox constant, as we do. They allowed the equinox to advance around the calendarial dates, and they calculated, when necessary, the date on which the equinox falls in any given year, either in the future or in the past.

Time Kept by Three Methods

This would be relatively easy to do if the year consisted of exactly 365 days, or of 365¼ days; if the former, the equinox would always fall on exactly the same date; if the latter, it would fall one day earlier every four years. But it will not do the latter, as we have seen, because the year is not quite 365¼ days long. Consequently, if the Mayas had calculated that in 400 years' time, the equinox would fall just 100 calendar days earlier than it did on the first year of the 400, they would have discovered by actual observation that it would fall ninety-seven days earlier. It would then have been very evident to them that their calendar was not exact.

Patient archeological students have found that the Mayas made use of three principal methods of reckoning time: they had a calendar based upon the revolution of the earth around the sun; one based upon the revolution of the moon around the earth; and one based upon the revolution of the planet Venus around the sun. They also had calculations of the movements of other planets, such as Mercury and Mars, and they were able to calculate lunar and solar eclipses.

With the Mayas, the important unit in reckoning time was not the year, but the day. In stating a date on a monument or in a manuscript, they put down the number of days counted forward from a fixed point, which may be considered as the first day of their calendar count. Professor Herbert Spinden presents very impressive evidence to prove that this fixed point, or "first day," was, in our reckoning, October 14th, 3373 B. C. They would say, for example, that some event occurred 1,386,112 days forward from October 14th, 3373 B. C. This does not mean, of course, that they inaugurated their calendar at that remote date; it is a date that they

reached by calculation, and it may have represented to them the beginning of the world—the first day of the Mundane Era.

For ordinary purposes of life, however, it was convenient to use the year as a working unit, and they did so. They considered that the year had 365 days. They then divided this number of days into eighteen months of twenty days each, and added a group of five days to complete the count. The twenty days of the month each bore a distinctive name. They also had a sort of "week" of thirteen *numbers*. When they mentioned the name of any day in the month, they always accompanied it by one of the thirteen numbers. We can readily understand that if they have thirteen numbers to add to twenty-day names, the same number cannot be attached to the same day name except once in every 260 days. This group of 260 days forms the first unit the Mayas employed in their calculations; they called it tzolkin, which seems to signify "the book of days."

Furthermore, each of the days of a month had a position number reading from 0 to 19. Every day in the month, therefore, had, first, a name; second, a "week-day" number; third, a position number, which indicated the position of the day name in the particular month.

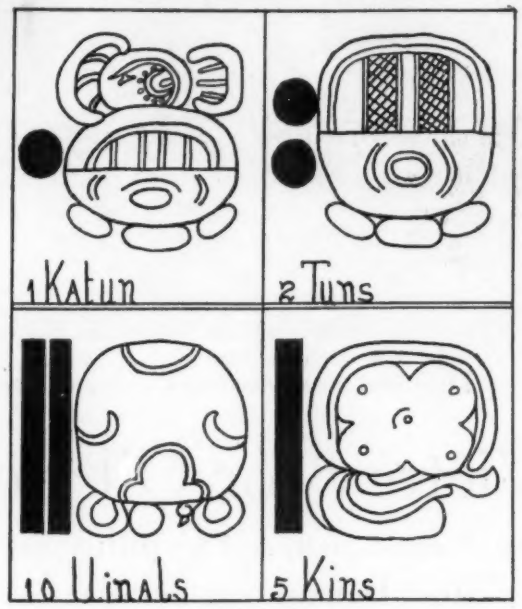
Finally, the eighteen months each bore a separate name. The first five-day names, with accompanying day numbers, were 1 Imix, 2 Ik, 3 Akbal, 4 Kan, 5 Chicchan. The first five of the days of the month Pop were numbered 0 Pop, 1 Pop, 2 Pop, 3 Pop, 4 Pop. If Pop began with 1 Imix, the resulting combination would be 1 Imix 0 Pop, 2 Ik 1 Pop, 3 Akbal 2 Pop, 4 Kan 3 Pop, 5 Chicchan 4 Pop, and so on. The long number, such as 9.12.10.5.12 corresponds, roughly, with our year number, such as 1924. 1 Imix would correspond, let us say, to a Sunday, while 0 Pop might be taken to represent 1st of January. If we were to write one of our dates in the order used by the Mayas, we should say 1924, Sunday, 1st January.

Mayas Used Vigesimal Notation

We have noted the tzolkin, or 260-day period, which forms a closed cycle based on thirteen numbers and twenty-day names. The year, however, has 365 days; so the Mayas had to calculate the relation of the tzolkin to the 365-day year. The problem that suggests itself is this: If the first day of the year, called Ik and bearing the number 1, and the first month, called Pop, the first of whose days bore the number 0, were to coincide and give us a year beginning 1 Ik 0 Pop, how long would it be before 1 Ik 0 Pop would again coincide and begin a year? By calculation it is found that this will occur only after an interval of 18,980 days; which is exactly fifty-two years of 365 days each. But it is also seventy-three times 260 days. The former period, fifty-two years of 365 days each, forms a closed cycle, and is called a calendar round, because a day-number plus a month position number, plus a month name, can repeat itself only after a lapse of 18,980 days. It has then gone all the way round the calendar and come back again to the starting point.

If 1 Ik 0 Pop began any given year, it would not be able to begin another year until fifty-two years had passed. Then it would again coincide with the first day of the year. But it would not coincide with astronomical time, because the true length of the year is 365.2422 days, and not 365 days.

The Mayas were thoroughly competent to make astronomical observations to determine the equinox, and they naturally would have discovered by such observations that the day on which the equinox actually fell rapidly drew away from the day calculated for the equinox on the basis of a 365-day year. They would thus discover the displacement of the date chosen as the first day of their year.



MAYA FOR "8,125"

For numbers above twenty they wrote a position sign with a bar-dot number to indicate how many times it was taken

Before we can understand the dates of the inscriptions, we shall need to find out what date in our Gregorian calendar corresponds to any given date in the Maya calendar; we shall adopt for this purpose the results presented by Professor Herbert J. Spinden in his recent work, "The Reduction of the Mayan Dates," published by The Peabody Museum of Harvard University in 1924. By Professor Spinden's method it is possible to choose any Maya date and find the corresponding date in our calendar. Thus, Maya date 7.1.13.15.0. 9 Ahau 13 Cumhu is equivalent to 10th December, 580 before Christ.

We shall have to make a brief explanation of the Mayan arithmetical system, in order that the Maya method of stating a date may be understood. Without such an explanation, a number such as 7.1.13.15.0 conveys nothing to the mind.

In our arithmetic we use a decimal system of position, or period value notation, each position, or period, from right to left being ten times the value of the preceding. Thus, if we write the number 6,405 in such a way as to display the position-value of each figure, we should have:

$$\begin{array}{rr} 1 \times 5 = & 5 \\ 10 \times 0 = & 0 \\ 100 \times 4 = & 400 \\ 1{,}000 \times 6 = & 6{,}000 \\ \hline & 6{,}405 \end{array}$$

We call the first position, or period, from the right "units"; the second "tens"; the third "hundreds," and so on, each position having a value of ten times the preceding.

The Mayas used a system of vigesimal progression with position-values of twenty instead of ten. That is to say, their first position (our "units") ran from 1 to 20; their second from 20 to 400 (20×20); their third from 400 to 8,000 (400×20), and so on.

Translating Our Dates Into Mayan Dates

But in making their astronomical calculations, they used a vigesimal system modified in an extraordinary fashion. This modification was probably the result of powerful religious convictions, which we have not space to consider now, interesting as they are. For astronomical purposes, they did not proceed regularly by twenties. They began with a first position valued at 1—20; *a second position* valued at 20—360 (18×20, instead of 20×20); a third from 360—7,200 (360×20); a fourth from 7,200—144,000 ($7{,}200 \times 20$); and a fifth from 144,000—2,880,000 ($144{,}000 \times 20$).

The first position was called "kin"; our number 17 would be 17 kins. The second was called "uinal"; our number 40 would be 2 uinals (2×20). The third was called "tun"; our number 1,080 would be 3 tuns (360×3). The fourth was called "katun"; our number 14,400 would be 2 katuns ($7{,}200 \times 2$). The fifth was called "baktun"; our number 432,000 would be 3 baktuns ($144{,}000 \times 3$). The symbols for these position-values, called "period glyphs" by students of Mayan mathematics, are shown at the top of the opposite page, omitting the two on the right.

A Maya number written 3.7.2.0 is read 3 katuns, 7 tuns, 2 uinals, 0 kins. To convert it into our system, we reduce it as follows:

$$\begin{array}{lrr} 0 \text{ kins} & 1 \times 0 = & 0 \\ 2 \text{ uinals} & 20 \times 2 = & 40 \\ 7 \text{ tuns} & 360 \times 7 = & 2{,}520 \\ 3 \text{ katuns} & 7{,}200 \times 3 = & 21{,}600 \\ & & \hline & & 24{,}160 \end{array}$$

To reduce one of our numbers to the corresponding Maya number, we reduce by a series of divisions. Let us take our number 8,125.

$$\begin{array}{llll} (1 \text{ baktun}) & 8{,}125 - 144{,}000 = & 0 & \text{baktun} \\ (1 \text{ katun}) & 8{,}125 - 7{,}200 = & 1 & \text{katun, plus 925} \\ (1 \text{ tun}) & 925 - 360 = & 2 & \text{tuns, plus 205} \\ (1 \text{ uinal}) & 205 - 20 = & 10 & \text{uinals, plus 5} \\ (1 \text{ kin}) & 5 - 1 = & 5, & \text{plus 0} \end{array}$$

Our number, 8,125, therefore reads in Maya, 1 katun, 2 tuns, 10 uinals, 5 kins; stated in positions, it becomes 1.2.10.5.

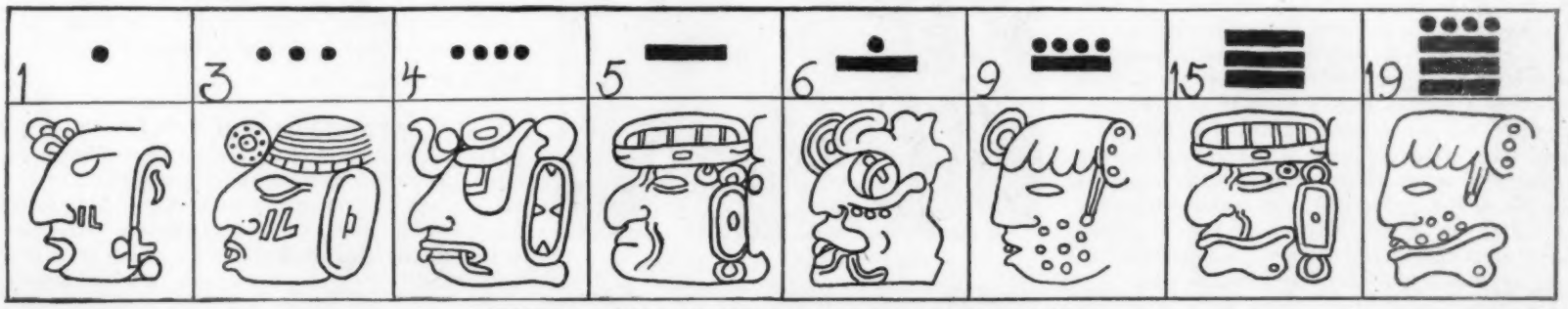
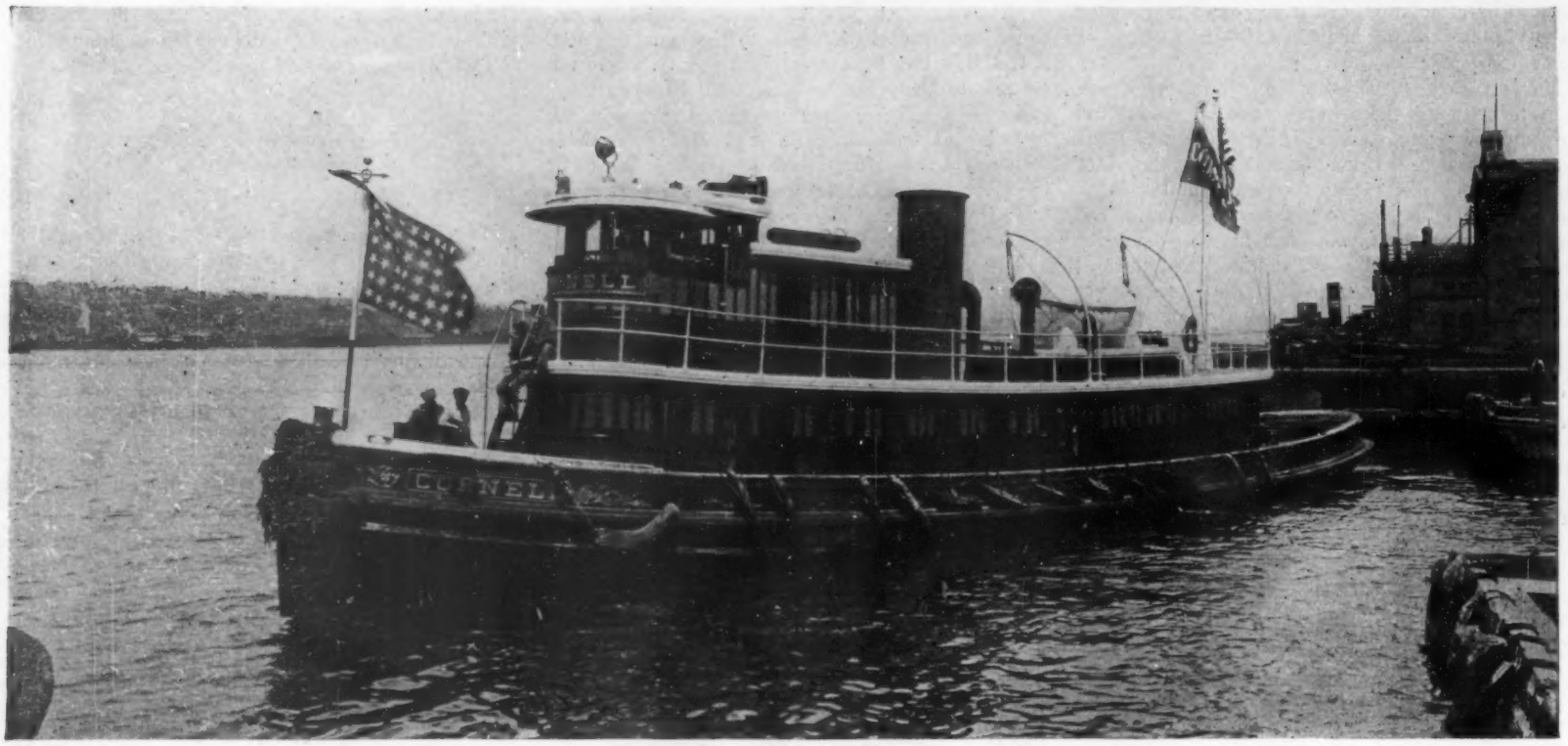


FIGURE UP YOUR INCOME TAX WITH THESE NUMERALS

In many inscriptions, the bar-dot numbers are replaced by these face numbers. Faces represent the series from 1 to 20



THE TUGBOAT *CORNELL*

A steam tug rebuilt for oil engine installation. Note the low stack which is possible in this type of equipment

Another Victory for Oil Equipment

A Diesel Engine Installation With Greatest Flexibility and Ease of Operation, in a Most Demanding Service

By Louis S. Treadwell

THE log of the tugboat *Cornell* reads, "April 18, 1925, 2:00 A.M. to 2:45 A.M. making up tow 16 barges East River, 540 signals."

A control movement by the engineer every five seconds! Trite and stoical it appears on the log, yet how much it imports of human effort and wear and tear on machinery.

Diesel engine installations are an undoubted success in marine service where the operation is in one direction or with only an occasional reverse as in tramp service or in long distance freighting. But where the demand is frequently full speed ahead to full speed astern or the intermediary notches, continuously for long periods, it will readily be appreciated that the conditions in towboating are far too strenuous for the standard reversing oil engine.

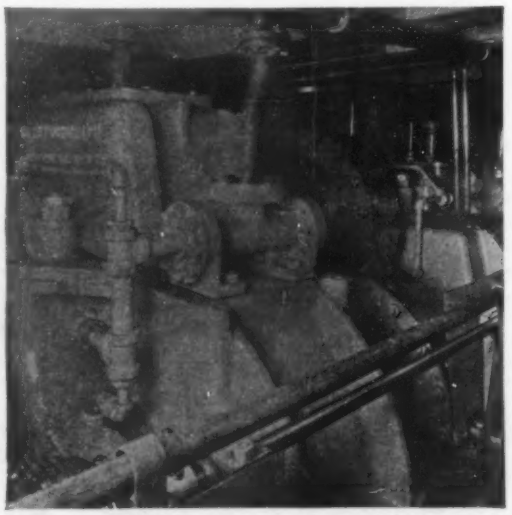
Stringent Requirements

To stand up under the stringent conditions and to overcome the inherent defects of the oil engine reversed by compressed air, with the sudden chilling of cylinder walls, the cost of compressing air for this purpose and the necessarily slow response to the reverse movement, the engineers of the Cornell Steamboat Company have developed an equipment on their tugboat *Cornell,* which for flexibility, positiveness of action, speed of change, and ease of operation is so superior as to warrant the assertion that this motive power will soon replace steam for towboating—at least in moderate sized plants. There are, moreover, economic considerations of great advantage which will be mentioned later.

The *Cornell* is 92 feet on the water line; has "N. L. S. & E. Co.'s" Diesel adaptation of six cylinder and air compressor, rated 360 brake horsepower at 240 revolutions per minute, with fuel capacity for eighteen days. This motor drives through a reduction and reversing gear, a propeller 8 feet in diameter of 9 feet 6 inches pitch with a speed of 102 revolutions per minute.

Flexibility with Positiveness

The crux of the great flexibility of operation lies in the oil pressure control of the two clutches. By reference to the diagram it will appear that when the lever (27) which controls the engine and hydraulic clutches, is moved to position marked ahead, the clutch cam (28) causes the clutch control piston valve (24) to move down uncovering the port opening and allowing oil from the high-pressure tank (21) to flow through supply pipe (25) to the clutch (7), engaging the ahead-motion pinion shaft (9) direct to the motor, and causing the propeller shaft (16) to revolve, and the boat to move ahead. When the lever is moved to position marked astern, the astern-motion clutch (8) and pinion shaft (11) are brought into action through gears (4) and (6) in a similar manner, the piston valve (24) at the same time uncovering the port opening from the ahead-motion clutch, and allowing the oil to escape through pipe (31) to the open sump tank (17).



AN INTERIOR VIEW OF THE *CORNELL*

The accessibility of the clutches and auxiliary parts, as well as the compactness of design can readily be seen in this view taken from the port side looking aft. Just out of sight on the left is the large flexible coupling connecting the engine to the reduction gear

When lever (27) is moved to the first notch, either ahead or astern, the engagement of the clutches is completed. On further movement of this lever in either motion, the speed of the engine is accelerated, gradually, by means of engine cam (29), and fuel control lever (30), until full speed in either direction is obtained. Thus a single lever, with the usual notches and ratchet stop, operates two cam-ways simultaneously.

Fuel Supply Coincident with Control

The first movement of the control lever either way affects only the clutch control, the second cam-way being a circle through this movement. A further movement brings the second cam-way into operation controlling the fuel admission to the cylinders. The farther the lever is thrown, the more fuel is admitted to the cylinders. During this latter movement the first cam-way describes a circle (28). A four-cylinder oil pump (18) furnishes pressure for the

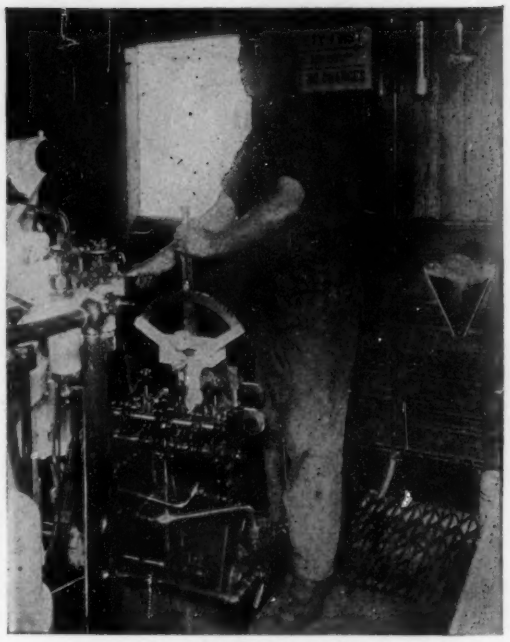
system and relief valves on both clutch pressure lines, by-pass excess pressure to the sump. Thus it is clear that one clutch is positively released before the other can obtain pressure. The oil-pressure medium not being subject to agitation, retains its viscosity and does not saponify or become aerated. Its action therefore is dependable for an indeterminative period. Flexible couplings (2) and (15) are provided to neutralize vibration.

In the last analysis it is the clutches which must stand the brunt of operation. They are of interesting design. Discs of fibre and steel are expanded against one another by oil pressure entering through hollow shafts, aft of the reduction gear housing. Because of the positive action of the pressure medium, there is no slip, consequently no heating and after two months' operation on twenty-four hour service, accurate calipering shows a wear of only 3/1000 of an inch—practically the wearing down to bearing surface only.

Although no heat has been generated in the clutches to date, should this develop in future operation, particularly during the hot summer months, ample means of cooling can readily be provided through the medium of the oil which operates the clutches.

Reduction Gear Increases Economy

The interposition of the reduction gear makes possible the operation of the motor at its most economical speed and the revolution of the propeller at different speed for its maximum power. Variations in the ratio of engine and propeller speed can readily be attained by changing the gears on the three shafts of the reduction gearing, thereby obtaining any desired number of revolutions for the propeller so that a standard design can be adopted which will cover a wide range of applications, each suited to the power of the individual plant and the varying characteristics of hull design. In repowering an old vessel, this latter consideration often limits the propeller proportions so that, were it not for the almost limitless combinations possible in the reduction gear, serious difficulty would be experienced in obtaining the correct power for the tug.



THE CONTROL PUMP

This four-cylinder pump automatically maintains oil pressure in the control system. It is driven by a chain belt from the main shaft. A single lever only is manipulated which operates the clutch coincident with the oil injection, making it impossible to stall the engine

In passing it may be mentioned that oil pressure has also been tried out and proved very satisfactory in the steering-gear control, which is of the ram type, mounted athwart the stern overhang; thus occupying space used ordinarily for a gear locker, and obviating the necessity of an independent power unit for this purpose.

Oil Equipment a Time Saver

It is the economic features of this installation, however, that are perhaps the most noteworthy.

Diesel power being practically adapted, all the advantages of the oil engine *versus* steam are applicable for this particular service. No time is consumed coaling and watering. Twenty-four hour service is assured.

When it is considered that a steam tugboat must run to the coal bunkers for fuel and oil; that coal has to be trimmed four times to fill the tug's bunkers; and that these limit the steaming radius to about one-fourth that of the oil equipment; it will readily appear that if this lost time can be eliminated and full time expended on operation, the resultant saving will be very large. Other advantages might be cited, such as the considerably reduced crew that is now carried, and the cleanliness of ship and engine room, making for higher standards and efficiency of all hands aboard.

These savings would apply equally to any other oil engine installation were it not a fact that until the plant we are describing was designed and worked out, an oil installation was not found practicable for the peculiar demanding conditions of towboat work.

Manipulations Are Foolproof

No power is consumed in compressing air for other than starting purposes. The clutches are readily accessible and can be broken down and reassembled in three hours. Even should wear develop, the repairs and upkeep will be a very minor expense—nothing compared to the advantages gained. There is no possibility of stalling the motor. When the engine is idling, both clutches are released and throwing from ahead to astern, the neutral point must be passed. As the load increases on the motor, more fuel is coincidentally supplied by the operation of the second cam-way of the control lever. Fuel is thus supplied only as additional power is demanded and the consumption is minimized to the actual needs of operation. Combustion being regulated automatically, a maximum efficiency is possible. Single-lever control minimizes human effort and the flexibility of shifting places a limit of operation solely on the rapidity with which signals can be given from the bridge. The manipulations are automatic and "foolproof."

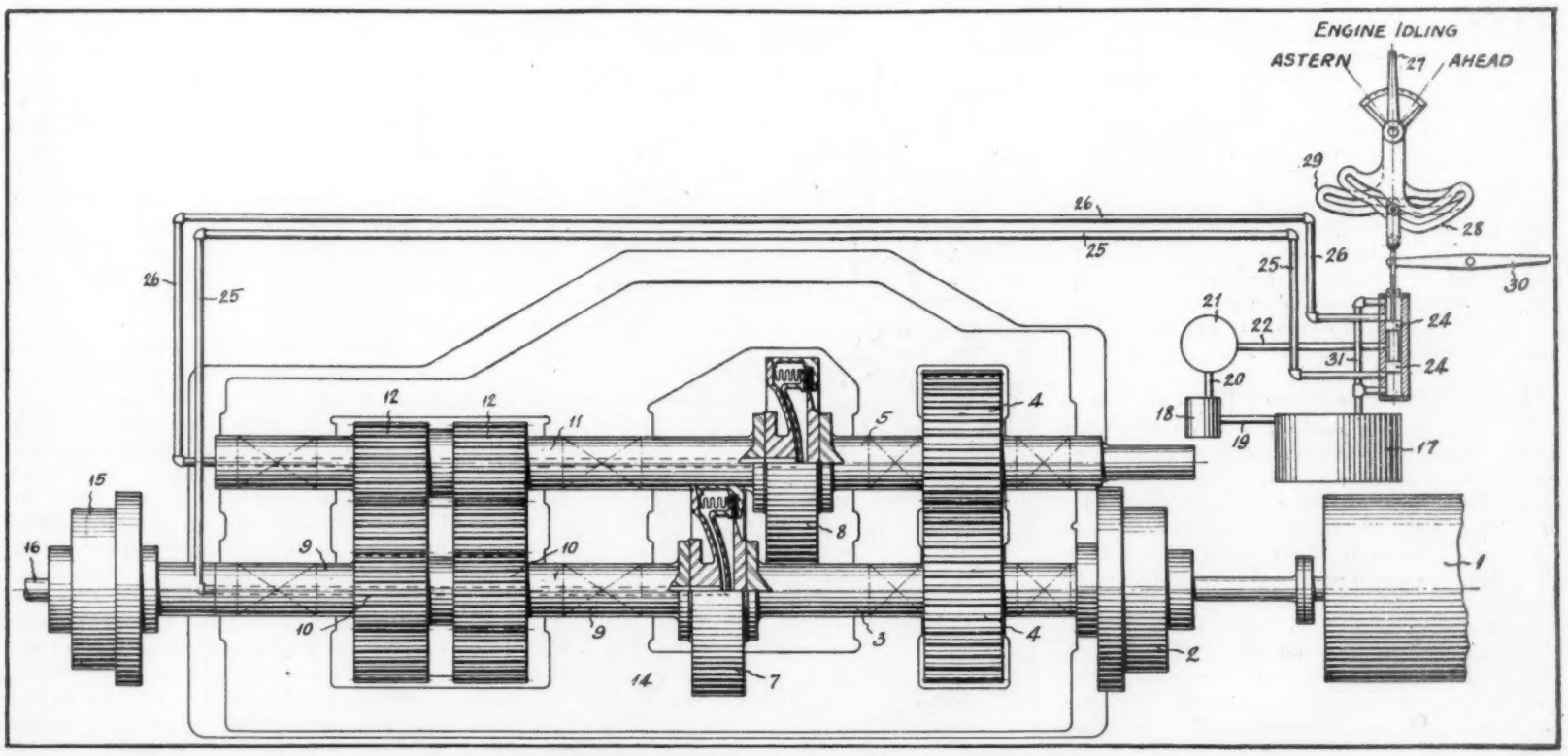


DIAGRAM OF THE OIL PRESSURE CONTROL SYSTEM

The oil pressure lines can readily be traced from the pump to the forward clutch, Number 7, and the astern clutch, Number 8, through pipes Numbers 25 and 26, respectively. Relief thermostats are not shown, but are installed on both lines to assure steady pressure. The large flexible couplings, Number 2 and Number 15, neutralize vibration so that the clutch housing is quiescent

Glacier National Park

Sunset on Upper Two Medicine Lake in Glacier National Park

Linking Mexico and California

Unbroken Rail Journey from San Francisco to Mexico City, Will Soon Be Possible

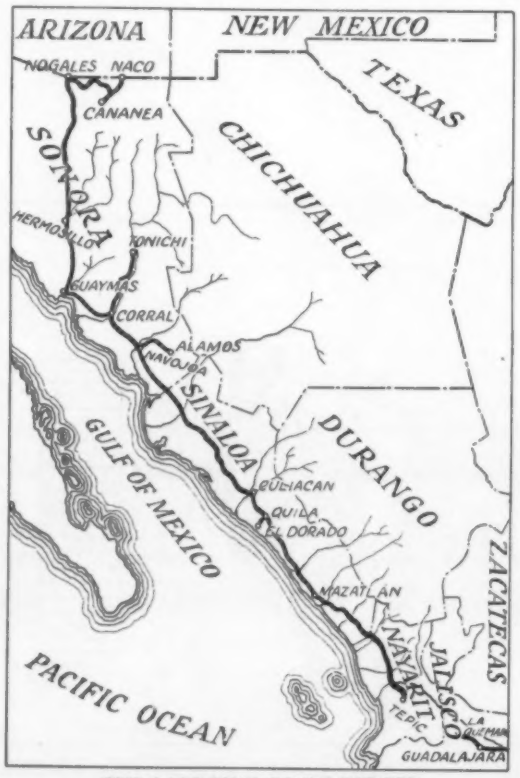
By George F. Paul

THE west coast of Mexico is about to be rediscovered through the linking of California cities with the capital of Mexico. Work is being rushed on the extension through the rugged mountains to the west of Guadalajara that will make through travel possible along the west coast. For centuries the mountains have successfully opposed their barriers to travelers, no matter in which direction they were bound. Pack trails wind their way along the edge of gorges, or make a giant swing to avoid a dangerous slope. It is only through the building of 29 viaducts and the construction of 33 tunnels that it will be possible to overcome the mountain barrier and complete the 100-mile link that makes possible a continuous journey by rail from San Francisco to Mexico City.

Mountain Torrents Dispute Right of Way

Just what this new roadway of travel will mean for the traveling public can be understood by referring to the accompanying map. Trace the course of the present operating railroad down from Nogales in southern Arizona, on the Mexican border, to Guaymas, on the Gulf of California. Then strike off to the southeast, down the coast, and follow the line through Mazatlan and on to Tepic. There is a railroad line striking off to the west from Guadalajara, which is to the southeast of Tepic. Well, here is the gap, from Tepic to Guadalajara, that must be bridged; here are the mountains that must be pierced—and that is the work which is now being done.

The difficulties of reaching Tepic from Guadalajara at the present time show the crying need for such a line. There is no smooth Lincoln Highway between the two cities. Instead, there are plenty of deep barrancas and brawling mountain torrents to dispute the passage. The traveler runs out the seventy miles to the end of the line from Guadalajara and finds himself at La Quemada, signifying the Burned Place. Here he hops into an automobile which, after many twists and turns and coughs and groans, brings him to a deep barranca that effectually blocks all further motor travel and compels him to resort to good old Dobbin, personified at this point by a sure-footed Mexican pony. For more than three hours he entrusts himself to this knowing beast; and he may even want to brag of his own skill as a horseman when he slips out of the saddle at Ixtlan. Here he has a chance to rest for the night. He should be in good shape in the morning for the last leg of the adventurous trip by auto to Tepic.



THE LAST LINK TO BE FORGED

Break in black line at bottom of drawing shows strip from Tepic to La Quemada which completes railroad

Tunnels Five Miles Long

The native Mexican laborers who are building this international link of steel have had many difficult tasks to face; for the construction work has been through a wild region where the highways are merely goat trails and where at certain seasons of the year the tropical rains descend with torrential fury. In spite of the many dangers of rock slides, of premature explosions, of all the shifting hazards that tunneling and bridge-building involve, these Mexican peons have kept steadily at the task, burrowing deep into the mountain sides and building bridges of steel across the yawning gorges, until today the work has reached the point where its successful and early completion is assured. Construction figures show that the tunnels on this section have a total length of five miles. From these tunnels 300,000 cubic yards of rock have been removed, or about one-twelfth of the total amount of earth and rock to be moved.

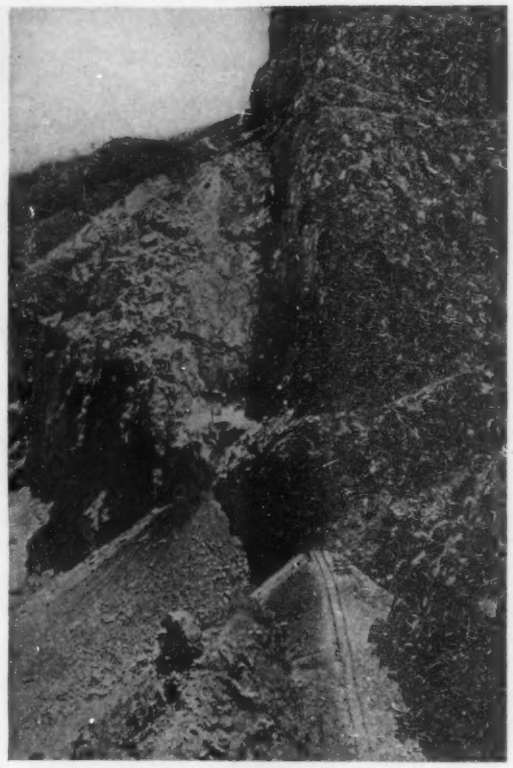
A BIT OF A REAL SCENIC RAILWAY

Ruggedness characterizes the route of the new link. Note the cuts and fills in foreground and distance

It is refreshing to speculate on the travel possibilities of this new line. Whether a person can take a trip or not, he can at least plan one that he might be able to take at some distant day when the goose shall hang high. For the New Yorker bound for California, the ocean and the mountains are waiting. He can take a steamer down the Atlantic, land at Vera Cruz, and climb by rail through emerald coffee plantations and shady banana groves to the foothills of Mount Orizaba, set like a gigantic lighthouse on the verge of the central Mexican plateau. On passing this sentinel he will find the scene suddenly shift. Before him will stretch the plains that form the bowl of this mountain-hemmed cup. Here the maguey plant grows to perfection. Millions upon millions of these graceful plants stretch away from one side of the horizon to the other in endless serried ranks. Off beyond gleam, like shields of burnished silver, the fairy lakes that surround Mexico's famous capital. This is the land of Montezuma the mighty and of Cortez the conqueror. History is written on the broad highways along which have traveled the warriors of many nations.

From the capital the way leads over the silver hills to Queretaro, where was enacted the last scene in the drama of the imperial monarchy that Maximilian attempted to establish. The curtain was rung down when he faced the firing squad on the side of the Hill of the Bells, near Queretaro. On past Mexico's mountain lake, Chapala, where some of the world's most beautiful sunsets are produced as the earth turns on its well-oiled axis. Then on to Guadalajara, clean, vigorous, delightful—and so to Tepic and the west coast line that leads to California.

Here we catch a glimpse of a noble fortress that tells of the historic past; there we see an irrigation project that tells of a bright commercial future; now we get a peep at a white-walled hacienda that looms up like a feudal castle; then, the rounding of a curve reveals a mystic fairyland where prosperity dwells in the deep and fertile valleys and romance clusters round the mountain heights veiled by the fleeting clouds.



DEAD MAN'S CUT—JALISCO

An impassé of rock confronts the engineer. Material for great embankment comes from tunnel or other excavation

Seventeen Rivers to Be Crossed

Three states are comprised in the west coast region of Mexico—Sonora, Sinaloa and Nayarit. Sonora is, with one exception, the largest state in the Republic of Mexico, but that does not mean that it stands at the head of the list in other respects. The Mexican government has had repeated trouble with the Yaqui Indians, who have infested the most fertile and productive portion of the state. The lack of rail communication has also held the state back. The line crosses seventeen important rivers between Nogales and Tepic. As there has been no concerted plan to impound these waters for irrigation projects, there are hundreds of thousands of acres of remarkable agricultural lands that cannot at the present time be developed. Even today, without the conservation of irrigation waters available, the state of Sonora is producing more wheat than the population of the west coast of Mexico consumes. In the Yaqui valley is produced the famous "Edith" rice that is in big demand in Mexico and the United States. This valley also produces grapefruit of excellent flavor and the famous Sonora oranges, besides beans, peas, corn and other vegetables of the truck-garden variety.

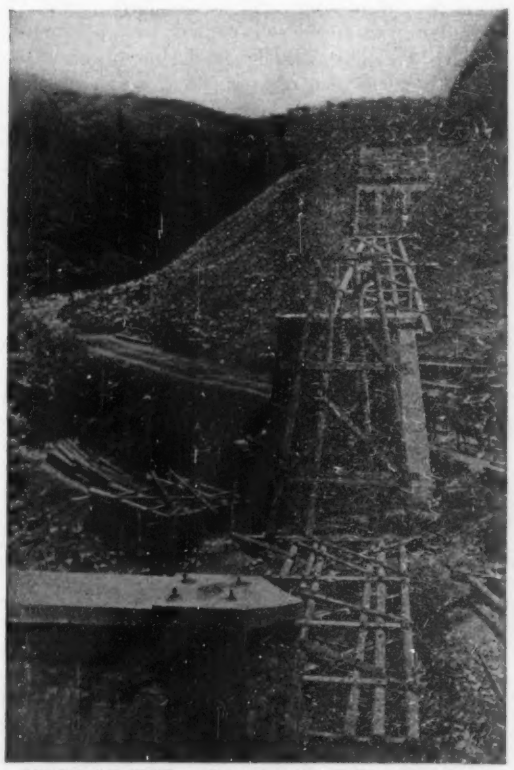
In Sinaloa there is great mineral wealth. The mountains are ribbed with silver; while in the valleys probably no finer cotton-land exists than is to be found here. Cane-fields with their attendant sugar-mills, fields of alfalfa, of corn, of beans, of chick-peas, of wheat, topped by the hillsides where the virgin forests stand—here lies the wealth of Sinaloa.

The state of Nayarit is still farther to the south, and consequently its products are more characteristic of the tropics. Cotton, tobacco, rice and coffee here spring into leadership. Some promising silver deposits are being worked in the mountains near at hand.

Such a new route of trade and travel cannot help but have a far-reaching influence on the entire region that it traverses. Trade may follow the flag; it certainly follows the railroad. A real chance to ship the product of a mine or of a field may mean that new lands will be developed and new plants will be established. The novelty of a round trip down through a brand new territory where every mile has its own story to tell will attract the traveler who is in search of something novel and different. The desire to get away from the beaten track, to do something different, makes a strong appeal to the American traveler who from a distance has looked with curious eyes on Mexico. The completion of this new 100-mile rail link will spell peaceful and too-long-delayed progress for a region of Mexico, where Yaqui and Mexican have written the history of a stormy past.

LOOKING NORTH TOWARD SOUTH PORTAL

In the foreground is an excellent bridge site and, beyond, a deep cut leads to the tunnel



WORK ON THE SOUTHERN PACIFIC RAILWAY

A bridge being built over the Maravalles River. The timber trestles are falsework for the steel spans

At the end of the chase Officer Bayless issues a "ticket" to an offender

Have We Too Many Traffic Laws?

The Difficulties of Enforcement from the Traffic Officer's Point of View

By James W. Bayless

WE HAVE many traffic laws—too many in fact; and serious thought must be given to their revision and standardization. The greatest trouble with our present laws is not that they fail to cover the situation, but that they are difficult to enforce. This difficulty of enforcement is caused: first, by the usual extremely defiant attitude of the motorist; second, by the great number of laws, all of which are elastic and confusing as to interpretation; last—and the greatest stumbling block of all—by the lack of a national standard for vehicle laws.

The stop plan is, in my opinion, only one more method of regulating speed—an admission in itself of the necessity for such regulation. But for reasons that I shall try to explain it is not feasible.

No Inducement Offered to Speed

Mr. Slauson's first point and his main idea, apparently, is that traffic regulations of speed do not curb recklessness or carelessness, or, in his own words, "Speed cannot be taken as a criterion of recklessness." That is an idea that has taken the popular fancy. It is due, without doubt, to the fact that most arrests of the motoring public have been for speeding, and such an arrest is an unpleasant experience, especially, if the accused feels that he has endangered no one, or that evidence has been obtained against him by the use of a so-called "speed trap."

This speed trap that we hear so much about, generally consists of a measured course of one-thirty-second, one-sixteenth or one-eighth of a mile in length, over which motorists are timed with a split-second stop watch and the speed approximated by use of a prepared chart compiled for the various distances and elapsed time. Properly laid out, the speed trap is very accurate; more so than any speedometer used on a vehicle trailing a suspected speeder would be. The word "trap" is a misnomer, for no inducement is offered the motorist to exceed the lawful limit, unless an exceptionally fine piece of highway may be called such an inducement.

Most enforcement officers will tell you that the objection on the part of the motorist to the speed trap is based mainly on the fact that the officer's testimony when offered at the trial is ironclad and offers no chance for dispute. Criticism has also been made of the use, or rather abuse, of the speed trap when it is laid on open highways where there is little danger in driving at high speed. This leads to the main point—the opinion which the motoring public has of traffic laws. Tell any convicted speeder or other traffic-law violator that he is a criminal and he will start some very drastic action to have you indicted or impeached. That is the key to the whole affair. We have traffic laws, yet the public regards them as mere regulations, and the traffic officers and courts they regard merely as referees or umpires.

Probably no article which has appeared in our columns in recent years has evoked quite so much comment from our readers as the one by Mr. Slauson in our May issue, entitled, "A New Plan for Traffic Laws." Many agreed with Mr. Slauson's suggestions, while others pointed out the difficulties which would be encountered by putting this plan into actual operation. One of the best opinions that has come to our desk is from a motorcycle officer, giving not only his own views but also those of his brother officers. We found his comments most interesting.

Knowing how many of our readers are making a study of traffic conditions, and believing that they would like to see this important question discussed from the point of view of the enforcement officer, we publish here in the form of an article this letter from an officer of the Venice, California, Police Department.

Present Laws Must Be Revised

If the traffic situation is to be regulated by law, such laws must be observed to the letter. If the laws are too drastic they should be modified or revised so that there would be fewer arrests, but so that conviction would be a serious matter. By this I refer to the present method of setting a limit at fifteen miles per hour and arresting at twenty-eight or thereabouts. Why have a fifteen-mile limit if an arrest for violation at, say, eighteen miles an hour would in all likelihood result in a dismissal for the defendant and a reprimand for the arresting officer? These needlessly low limits and the great number of minor traffic laws make it almost impossible to drive a car without violating some provision of the law. Such a condition promotes contempt for all law. It makes possible the "fixing" of traffic complaints and it is the reason why most people regard an arrest for a traffic-law violation as more or less a joke.

Before any solution of the problem is reached, this state of affairs must be remedied by passing laws which the people will regard as fair and just.

As to the practicability of the stop plan, I will cite my personal experience in enforcing a section of the vehicle act of this state, an act which provides that every vehicle shall have adequate brakes. To prevent disputes, the same brake-lining manufacturers' chart which Mr. Slauson mentions—but

with modifications—was used. We found, however, that no accurate estimate of the stopping distance could be obtained except by a second test in which an officer acted as observer of the speedometer and of the application of the brakes by the driver.

In order to use the method suggested by Mr. Slauson, an officer would have to estimate the speed of a car ordered to stop and then make a second test. No imagination is required to visualize the complications and argument that would ensue. Any traffic officer will tell you of the many and varied actions of motorists whom he is trying to halt. They do everything but stop, and if arrested under Mr. Slauson's plan, they would certainly object strenuously, claiming that they did not see the officer or that they did not understand that a stop was required. This is a truthful account of the kind of testimony rendered by many arrested motorists.

Does Speeding Constitute Reckless Driving?

From a study of police records it is apparent that careless, incompetent or wilfully reckless driving is most dangerous on congested city streets. On these streets, therefore, the greatest effort toward enforcement must be made. This fact will constitute the biggest drawback to the stop plan if one pictures an officer trying to stop a car which he has reason to believe is incompetently operated on a crowded street. In the event that he did succeed in making himself observed and the signaled car did stop, a serious accident might result due to following machines crashing into the rear of the halted car. Difficulty of this kind would be apt to influence officers to use less traveled streets for tests, thus placing the stop law in line for the same criticism as the speed trap.

Thus, in a comparison of the two methods—enforcement by the stop plan, or speed enforcement by the so-called trap—the latter has the advantage in that it may be used anywhere and is especially advantageous in heavy traffic.

To make any law effective, officers must have some means of obtaining evidence that will convict. In cases of prosecution for reckless driving, the speed of the car is always the paramount issue; but I can anticipate the objection which will be made to this assertion. No doubt it will be said that the main point is to prove or disprove the fact of the car being under control. I shall cite an example.

Picture a crash at an intersection of highways. An officer witnesses the accident. One of the parties involved has driven in a reckless manner, has approached the intersection at high speed and, in general, has operated his car in a careless manner. The officer arrests the careless motorist on a charge of reckless driving. At the trial the defendant pleads not guilty and states that he had his car under control, that he is a skilful driver and that the other party to the crash usurped his right of way. A study of the case shows that the defendant has violated no rule of the road except that regarding speed. If the stop law were in effect, the defendant might also declare that he had stopped within less than the legal stopping distance. As no one could prove at just what point the accused applied his brakes, this statement could not be attacked. The officers' testimony would consist mostly of generalities, with no specific points of value. The motorist's testimony would have little weight because he is admittedly prejudiced. A conviction would be doubtful. On the other hand, if the defendant were forced to prove that his speed was under a set limit, the officers' testimony would be expert testimony and it would probably convict. If the accused had passed through a trap and the officer were in pursuit, there could be no doubt of conviction.

Partial Bail Schedule for Violation

S No.	OFFENSE	MIN.	MAX.
41	Registration certificate not in vehicle		5.00
43A	Number plates not displayed	5.00	25.00
43B	Illegible or swinging plates		5.00
51	Fictitious license	25.00	50.00
58	No operator's license		5.00
74	Driving while license suspended	Jail	
75	Permitting unlicensed minors to drive	10.00	25.00
94	Inadequate brakes	10.00	20.00
95A	No horn		5.00
95B	Unlawful siren	25.00	35.00
99	No lights	10.00	25.00
101	Glaring, inadequate, illegal headlights.....*bail can not be taken*		
108	Illegal spot light—glaring	5.00	15.00
112	Intoxicated driver	Jail	
121	Reckless driving	25.00	150.00
122	Driving on left side of road	5.00	25.00
124B	Passing between	25.00	50.00
125	Overtaking and pass to the right	10.00	25.00
125C	Passing on intersection or blind curve	10.00	40.00
130	Improper or no hand signal	5.00	25.00
133	Failure to heed siren	25.00	50.00
136	Stopping so as to obstruct highway	5.00	25.00
141	Failure to render aid	Jail	
146	Operate vehicle without owner's consent	Jail	

Now, in defense of speed laws, there is a very important factor to consider. There is almost no traffic law violation, with regard to the actual operation of a vehicle, which is not directly traceable to speed, haste or desire for speed. Cutting corners is generally attributable to the driver being in too big a hurry to go around the button or traffic center. The failure to give a hand signal is attributable to the fact that the driver is too busy manipulating the wheel. In the case of an unlighted headlight, the driver is usually in a hurry to get to his destination. Cutting in ahead on narrow highways is due to impatience and haste.

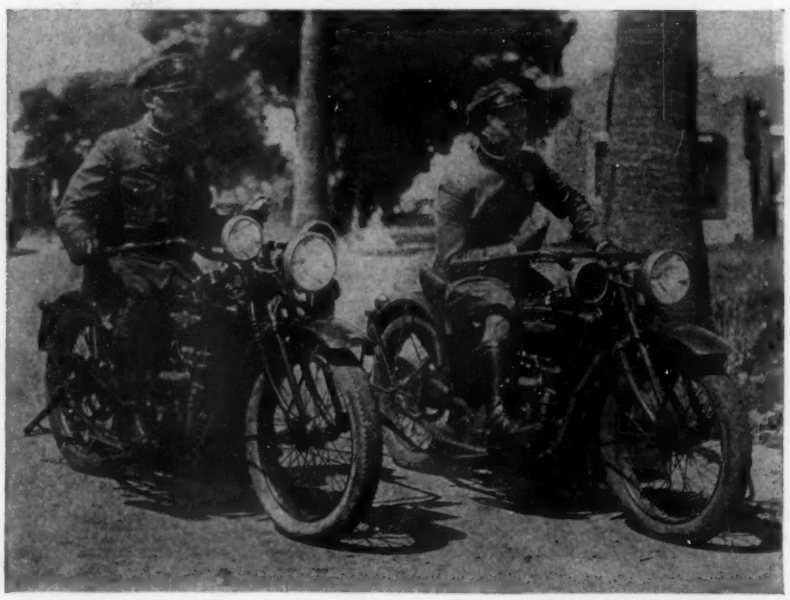
The mere fact that such a driver's brakes are good and that he can make a quick stop, means nothing in such cases. Also it must be considered that most of these violations are very minor affairs unless they are committed at high speed. Certainly, therefore, speed must be considered a criterion in such cases.

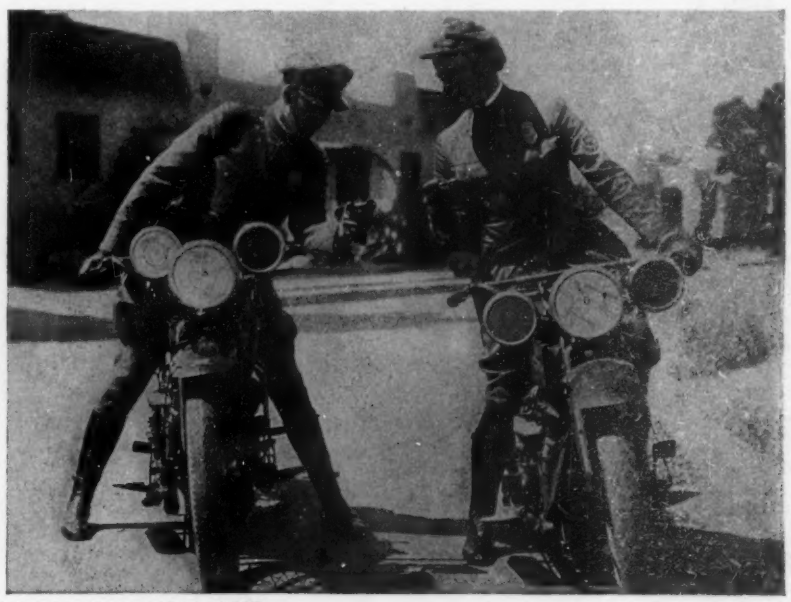
Raise the Speed Limits!

In California the speed traps have been eliminated and arrests for speeding must show not only the actual speed in excess of the specified limit, but they must also show that the car was operated in such a manner as to endanger life and property. During a year and eight months' trial the enforcement of this idea has proved to be a failure.

Again and again it has been suggested by the police to raise speed limits to the point where a violation is a serious matter. Let it be understood that the speed limit *is* the limit, and then let evidence be obtained against violators by the most accurate method possible. Regardless of any type of brake equipment, speed in excess of twenty-five miles per hour on a business street, is dangerous. Therefore, it should be understood that any speed over twenty-five miles per hour will bring arrest. Let the same action take care of the residence sections and the open highway. Forty miles an hour is suggested as a limit for open highways, or possibly forty-five miles. Set it high enough so that there can be no objection and then enforce this regulation strictly.

Summing up, Mr. Slauson's plan will no doubt prove a welcome suggestion in making a needed revision of the traffic laws. For certain conditions such a plan has many possibilities, but as a replacement for speed laws I do not think it is feasible.





TWO OFFICERS OF THE LAW APPLY THE SPEED TEST

Giving the motorist a fair start on a predetermined course *Comparing watches at the end of the test to insure accuracy*

Man-made Ears for the Deaf

Why Many Deaf People Hear Normally in Noisy Places and Over the Telephone. New Advances in Sound Amplifiers

By Harvey Fletcher, Ph.D.

Photographs and Diagrams Courtesy of Bell Telephone Laboratories, Inc.

IN DISCUSSING aids to the hearing it is a common practice to make analogies between methods used in prescribing eyeglasses and in prescribing a definite type of hearing device. Such analogies frequently give a wrong impression of the nature of the problem. The principal function of eyeglasses is to correct defects in the optical part of the eye *without magnifying* the intensity of the light. The principal function of an aid to hearing is for increasing the intensity of the sound entering the ear. It is seen, then, that the problems of designing apparatus for aiding seeing and of designing apparatus for aiding hearing are essentially different.

Sounds as perceived by the ear have three essential characteristics; namely, pitch, depending upon the rapidity of vibration; loudness, depending upon the intensity of the vibration; and quality, depending upon the form of vibration.

Speech sound waves are very complicated and usually involve components having varying pitches and magnitudes. As these complicated waves are transmitted through the air, their form is preserved so that a listener near the speaker where the speech is loud receives the same form of wave as a listener at some distance from the speaker where the speech is weak. A listener at these two positions would interpret the speech received as being different in loudness but not in quality. If one wishes to magnify the speech sound for the purposes of aiding the hearing, the vibration *form* of the sound wave must be preserved, if the best results are to be obtained. All commercial hearing devices, of course, fall short of this ideal.

As a result of the practical problems of design and construction, distortions of one kind or another are always introduced, in spite of the fact that it is now known how to magnify the volume of sound almost to any extent without introducing distortion. The apparatus required for such ideal magnifications is bulky and expensive, and a compromise is necessary between lightness and compactness of the apparatus and its nearness of approach to the ideal in performance.

The Deaf Hear Well Over the Telephone

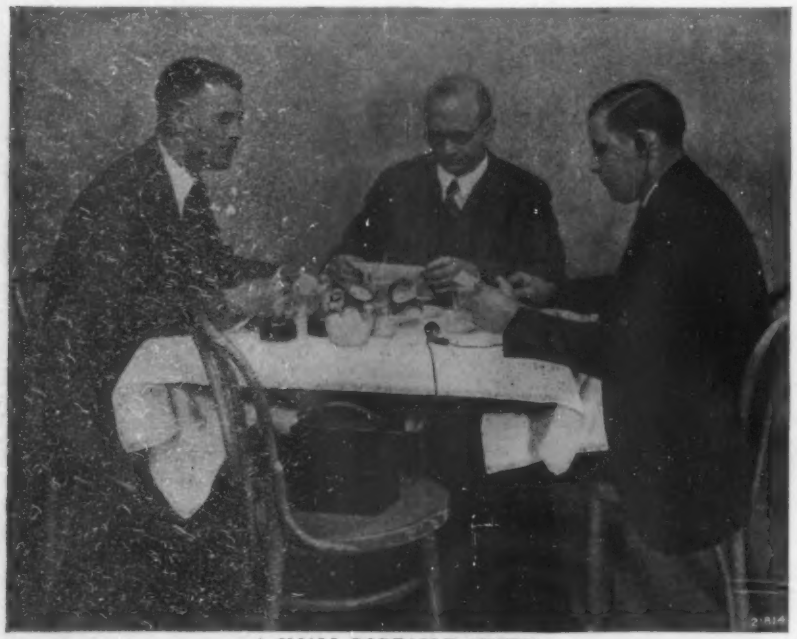
In the Bell System Laboratories we have made extensive investigations of speech and hearing, and have measured the effect of various degrees of deafness on the sufferer's ability to understand human speech. One who has less than a thirty percent loss of hearing will have little difficulty in understanding ordinary conversation at a distance of three feet from the speaker. Only the *f*, *th*, and *z* sounds are seriously affected. One having a forty percent loss begins to miss the consonants and would experience some difficulty in following the conversation; but by paying strict attention would probably be able to understand what is being said. One having a fifty percent loss in hearing can hear only the loud vowel sounds and consequently could not follow the conversation. It is only those who have a greater loss than forty percent hearing who are seriously inconvenienced in the ordinary affairs of life. However, the loss of from forty percent to fifty percent of the hearing becomes a serious handicap in the understanding of ordinary conversation. To make a person understand who has a fifty percent loss in hearing, people must either talk very much louder or get closer to the ear. A person having as much loss as sixty percent would not hear anything when a person was talking at a distance of three feet.

Our studies have also explained why certain sounds can be heard when partial deafness has cut off others. The human voice is most powerful in the lower pitches where we find the louder tones most useful for recognizing *a*, *e*, *i* and *o*. The voice contains much less energy at the higher pitches, where are the characteristic sounds for *t*, *p*, *f*, *s*, and *th*. These sounds, being formed by teeth and lip positions, can, however, be read by watching the speaker. Hence lip-reading has come to be of much use as a partial counteractive to defective hearing. Also, unless lip reading is to be depended upon, it is important to avoid many of the deaf sets now on the market, since they do not transmit the high pitches necessary to understand *f*, *s*, *th*, and other important consonants.

If noise is present in a room where one having normal hearing is attempting to understand speech, it has the same effect upon the interpretation of sounds as though the person's hearing were impaired. For example, in a room of about the average noise conditions the person having normal hearing can hear no better than a person having a twenty percent loss in hearing. In a very noisy place, such as on a subway train, the noise may be sufficient to raise the threshold for hearing other sounds than the noise from a point corresponding to normal hearing, up to a point corresponding to a sixty percent loss. This, of course, means that a person who has as much as sixty percent loss in hearing would be on terms of equality, from a hearing standpoint, with one having normal hearing when, for example, both persons are riding on a subway train. Hence, the person having defective hearing would *seem* to hear better in noisy surroundings than in a quiet location where a normal person's superior hearing would be apparent.

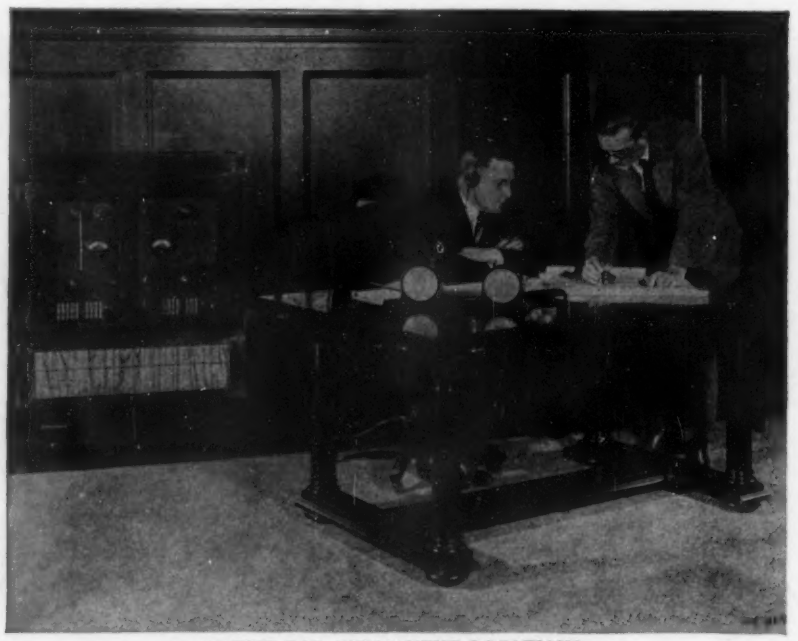
Persons who are hard of hearing and who understand this noise reaction frequently entice their friends into a noisy corner of the restaurant or club or invite them for an automobile ride where they converse with considerably less embarrassment to both those of normal hearing and those of subnormal hearing.

The reason some people can hear better over the telephone than face to face is that the speech energy delivered by the telephone receiver which is close to the ear is usually greater than that received by the ear from a speaker three feet away. On account of the noises that exist at most places where the telephone is being used a larger amount of speech power



A SMALL PORTABLE OUTFIT

Were it not for the audiphone in the vacant chair, another chair might just as well be vacant as far as its occupant's ability to hear is concerned



OUTFIT FOR PERMANENT LOCATIONS

By using two separated microphones the sense of direction characteristic of sounds heard normally is conveyed. Such semi-portable equipment is suitable for the home or office

must be delivered than would be necessary if things were quiet. For this reason more than 100 times more speech power is delivered to a telephone subscriber than is necessary for normal hearing in a quiet place. Consequently a person whose hearing is down so that it requires not more than 100 times more power than normal to hear has no difficulty in using the telephone. Incidentally, it is well to remember when telephoning in a noisy place that covering the transmitter mouthpiece with one hand or pressing one's cheek against it will shut out the noise from one's ear far more effectively than by stopping up the other ear.

How to Forestall Disappointment

Other tests have shown the effect of loudness on the ability to understand. In the case of people of normal hearing, there is little change in intelligibility over a wide range in loudness. At the lower end of the range the sounds are too faint to be understood; at the upper end they are so loud as to pain the ear. As hearing becomes impaired, the weaker tones become inaudible, while the ability of the ear to withstand louder sounds remains the same. When not more than sixty percent of the hearing has been lost, it is still possible, by increasing the loudness, to enable the sufferer from most types of deafness to understand ninety-five percent of what is said; but this degree of loudness is all that the ear will stand; and for greater degrees of deafness no further increase in loudness will be of any great value.

In certain types of deafness the hearing mechanism distorts very badly the sounds falling upon the ear so that the sensations produced are quite unlike those produced in a normal ear. A person having such a hearing defect might describe a clear flute-like musical note as a buzzing, hissing noise. In such cases no amount of sound amplification will enable the person to hear and understand speech except with considerable difficulty.

It is pathetic to see the disappointment of many whose desire to reestablish communication with their fellow men has led them to believe the extravagant claims of manufacturers of some sets. This disappointment can be forestalled in many cases by the following simple test:

The maximum volume of speech sounds which the ear will withstand can be reached with a little effort by speaking into the sufferer's ear in a loud voice. If he can understand enough of what is said to make it worth while, it is probable that an amplifier can be designed to give him the same degree of intelligibility.

MOLDED TO FIT THE EAR

A close-up of two of the little receivers—one in the ear and one out of it. These may be worn all day with no more discomfort than the wearing of eyeglasses

An amplifier is really an aid to the speaker, as well as the listener, and this way of looking at the problem is often useful. Since the human voice, raised to its maximum conversational loudness and put directly into a person's ear is already as loud as the ear can tolerate, the amplifier can do no more in that direction. What it does do, however, is to enable the speaker to use ordinary conversational tones, and to speak at a distance of several feet from the pick-up device, which in turn may be at any distance from the listener. This is much more convenient to the speaker, and since people object to talking loudly and directly into someone's ear, anything that promotes their convenience will increase the amount of conversation in which a partially deaf person participates.

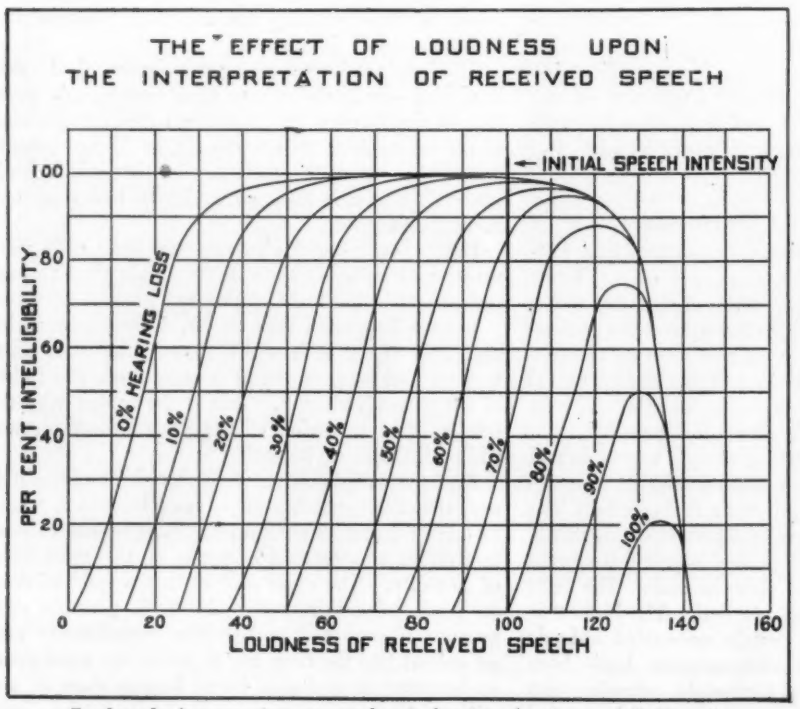
Electrical amplifying outfits are now available, from the largest size which gives the listener the maximum permissible loudness, even when the speaker is ten feet away from the transmitter, down to smaller sizes which with the speaker three feet from the transmitter will give the same intensity as if he spoke directly into the listener's ear. The first set would be suitable for large conversational groups, such as board meetings, and for extreme cases of deafness. Its size makes it about as portable as a small bookcase, which it resembles.

At the other extreme in size is the portable outfit, which consists of a microphone worn on the coat lapel, a vacuum-tube amplifier with batteries in a box weighing seven pounds, and a very small receiver which fits into the outer ear. Such a receiver weighs only six-tenths of an ounce and it has no headband. It can be worn all day without fatigue. A still smaller set without a vacuum-tube amplifier will soon be available; its weight will be less than two pounds.

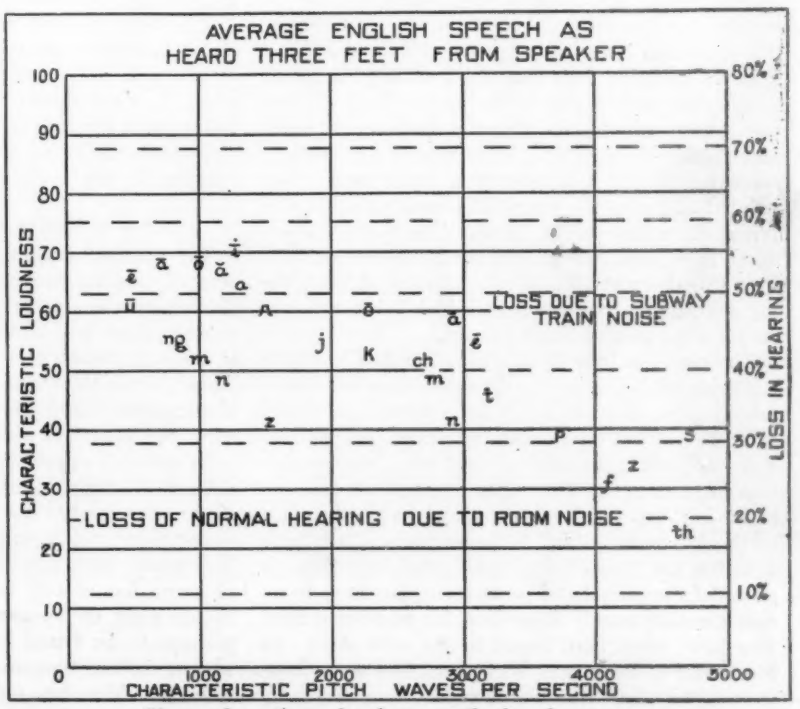
Test Hearing Appliances for Distortion

It is possible to devise a receiver without a headband by taking advantage of "the porches of the ear," immortalized in "Hamlet." The cartilages of the outer ear are rigid enough so that when an impression of them is taken and a molded fitting is made and inserted, this will support the little receiver without discomfort to the wearer. The design may be kept small because permalloy, the highly magnetic material recently discovered by scientists of the Bell Telephone Laboratories, is used in its construction. Not only does the use of permalloy in the magnetic circuit of the tiny receiver make it more sensitive, but it also prevents acoustic shock because it will amplify sounds only up to, but not past, a certain degree of loudness. Thus there need be no fear of using a receiver so intimately associated with the ear.

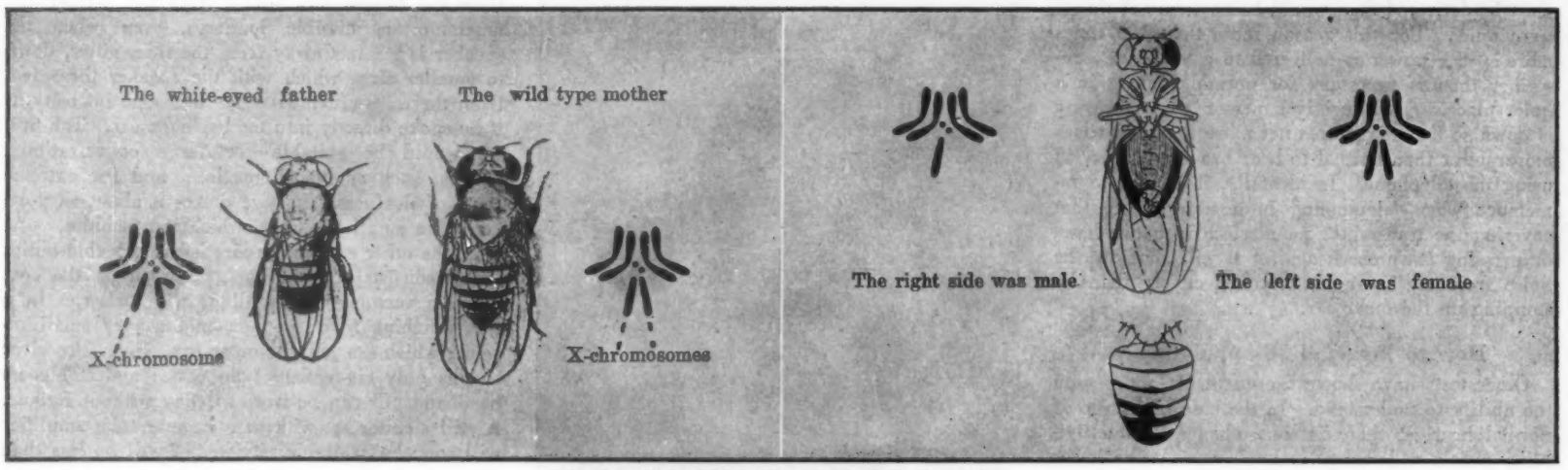
In this discussion it has been assumed that the complicated wave shapes of speech have been preserved without distortion by the electrical apparatus. When distortion is present, as it is to a serious degree with many of the hearing aids now on the market, the intelligibility is thereby reduced, sometimes to a point where the set is useless. It is, therefore, important in selecting a set to give it a careful test with this in mind. And before trying out sets, it is most desirable to have the degree of deafness measured accurately by an audiometer.



To those having over sixty percent loss in hearing, shouting is of little avail



The vowel sounds are heard more easily than the consonants



AN ANIMAL HALF MALE AND HALF FEMALE

The fruit fly shown in the right half of the illustration is the offspring of the two flies in the left half. Note particularly the eyes of the offspring, one white, one red, and compare them with those of its two parents on the left. One of the X-chromosomes which would otherwise have determined the fly as a female, was lost, and so it became half male.

What Is a Gynandromorph?

How One Insect Combining Both Sexes Resulted from an Accident to Its Sex Chromosomes

By James W. Mavor, Ph.D.
Department of Biology, Union College

THE lowest animals are not divided, like those which went into the ark, into male or female. Some, like the common earthworm of our lawns, possess the organs of both sexes within one body; although even these animals always need to mate in order to produce young. Others, like the snails on the garden wall, change with the season and are first male and then female. On the other hand all of the insects, without exception, are normally either male or female and it is usually not difficult to distinguish the sexes.

There are, however, certain abnormalities which may occur in almost any animal belonging to a group in which the sexes are normally separated. Such abnormalities make the animal different from either a male or female of its own species; while in some cases the animal may be intermediate between the two sexes. Because of the striking characters which insects possess and the ease with which they can be studied, more is known about these abnormalities in this class than in any other group of animals.

In the common fruit flies which during the warm weather are such a pest in the pantry the sexes can easily be distinguished. Our figure shows the male and female of this fly. The females are usually somewhat larger and possess a fuller and more pointed abdomen the pigmentation of which is different from that of the male. The male, on the other hand, has two minute structures on his fore legs, called sex combs. There are other distinguishing characters of the two sexes which it is not necessary for us to discuss at present.

The common fruit fly has been a valuable aid to the study of heredity. In the extensive work which has been carried out on it there have been found some four hundred distinct mutations or peculiar hereditary characters which breed true from generation to generation. One of these mutations consists in having eyes which are completely white in place of the bright red which is the normal color. Such a white-eyed race of flies will breed true through an indefinite number of generations, but there is no race question among these flies, for white-eyed fruit flies have never been found in the wild state. In flies, color is dominant. White-eyed flies seem, however, to be otherwise quite normal.

Now let us turn to consider a kind of individual which occurs only very rarely, even in flies, a gynandromorph. This word might easily stand for something terrible but it really means simply a creature which has the form of both a male and female. One of these anomalies is illustrated here. It appeared among the offspring of a white-eyed father and a red-eyed mother. A peculiar thing about it is that it is a bilateral gynandromorph. That is, the right sides of its head and thorax are male and the left sides are female. That this is so can be told from the sex comb which is present only on the right side. The condition is reversed in the abdomen, for here the left side is male and the right side is female. This is shown by the pigmentation of the abdomen and its anatomical structure.

But have you not already noticed a much more peculiar characteristic than any of those already mentioned? The right eye is white and the left eye is bright red (necessarily black in the figure). Our gynandromorph's father was a white-eyed fly and its mother was a normal red-eyed fly. A very extraordinary thing has happened. We have a fly one side of which is male and the other female. The side which is male shows hereditary characters of the father; and the side which is female shows hereditary characters of the mother. Rather weird? But now for the explanation.

Sex a Matter of Chromosomes

The process of reproduction is essentially a process of creating new cells from old cells. When this phenomenon takes place, the chromatin, which at other times is disseminated throughout the nucleus of the cell, gathers together in a number of threads. These threads thicken to form rod-like bodies, called chromosomes, and chromosomes are believed to carry the materials which determine heredity.

In each cell of every species of both vegetable and animal life there is a constant number of chromosomes, the number varying with the species. The lowest number, two, occurs in a certain small worm. This means that every cell in the body of this species of worm has exactly two chromosomes. The fruit fly has eight chromosomes per cell. The highest is perhaps to be found in certain one-celled animals where sixteen thousand chromosomes have been counted! Man has only forty-eight, showing that the number of chromosomes is not directly related to the position of the animal on the tree of life.

The chromosomes of the fruit fly have characteristic shapes and sizes and each cell has a full complement of them as shown in the illustration. One pair of these which differ from the others by being straight and rod-like are called X-chromosomes.

Now, the peculiar thing is that while any cell from the body of any female fruit fly has exactly four pairs of chromosomes shown in the figure—one pair being the X-chromosomes—in any cell from the body of the male fruit fly the two chromosomes corresponding to the X-chromosomes of the female cell are not alike, one being like the X-chromosome of the female and the other called the Y-chromosome, being quite different.

It has been shown that the hereditary characters and the sex characters are intimately associated with the chromosomes, and that a fly which has two X-chromosomes in its cells is for that reason a female, and a fly which has only one of these chromosomes (it may or may not have, in addition, the Y-chromosome) is a male.

The explanation of the gynandromorph is that it started out in the egg to be a female. At some time during its early life, possibly in the first division of the egg to form an embryo fly, an X-chromosome got lost in one of the cells so that that cell and all the cells which it later gave rise to had only one X-chromosome.

Having only one X-chromosome, these cells were male; and being in their nature male they formed male parts in the body of the fly.

It also happened that the X-chromosome which remained in the cells which formed the male parts was an X-chromosome which came from the father of the gynandromorph. This is the reason why the eye on the male side of the gynandromorph was white like that of its father.

From the explanation which has been given it is seen that the gynandromorph is of interest not only as one of Nature's curiosities, but is of much more interest as a very neat example of the mechanism of heredity. The clear and definite explanation of its mode of origin and make-up is possible only because it occurred in breeding experiments with an animal like the fruit fly, in which the mechanism of heredity is probably better known than in any other animal.

The Short-lived, Eight-foot Flower of Sumatra

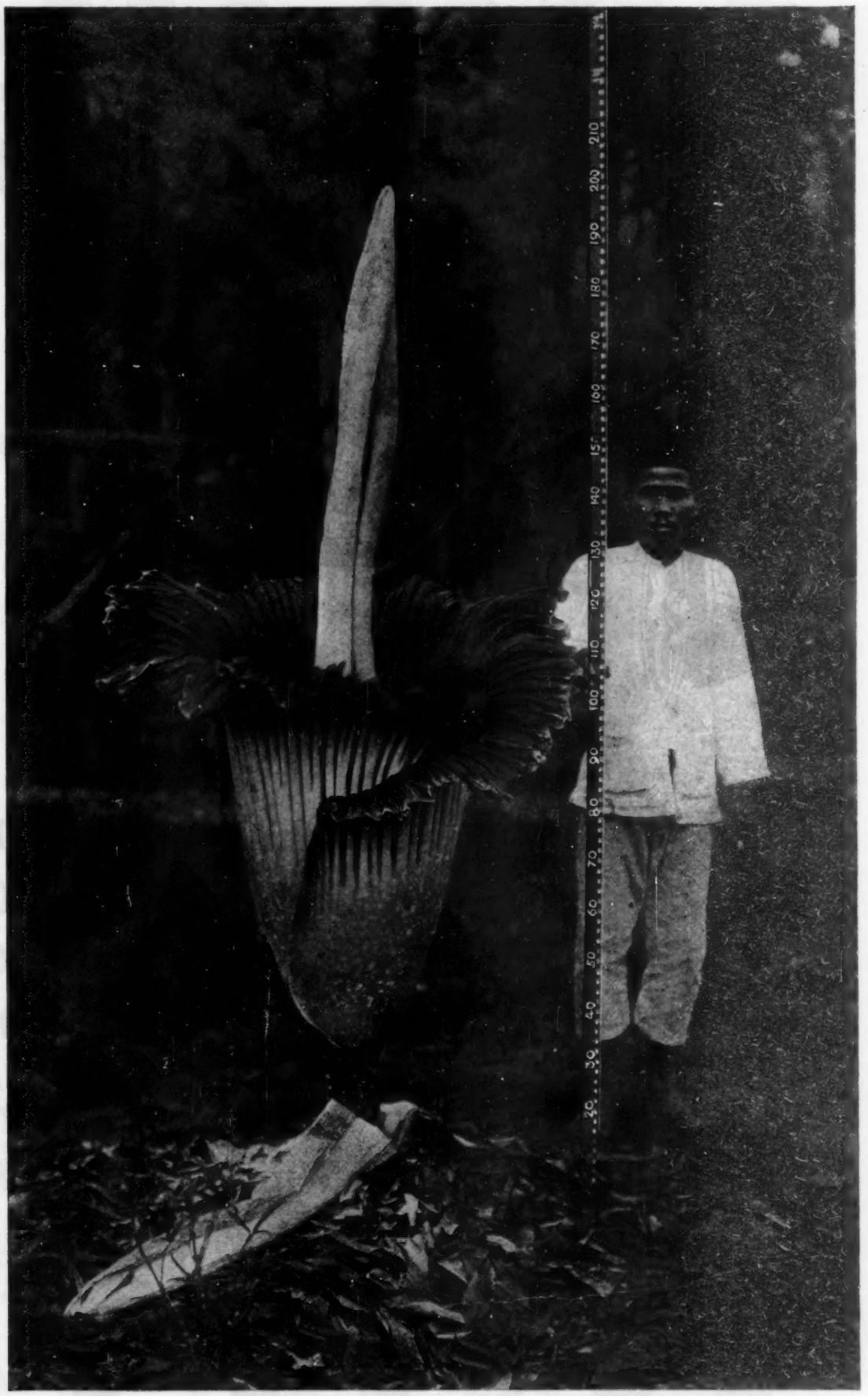
Photographs Courtesy of *Gardener's Chronicle*

INFANCY OF GIGANTIC FLOWER

After twenty-two days, the bud is only nineteen inches high

TWELVE DAYS LATER

The flower is now about four feet, four inches high

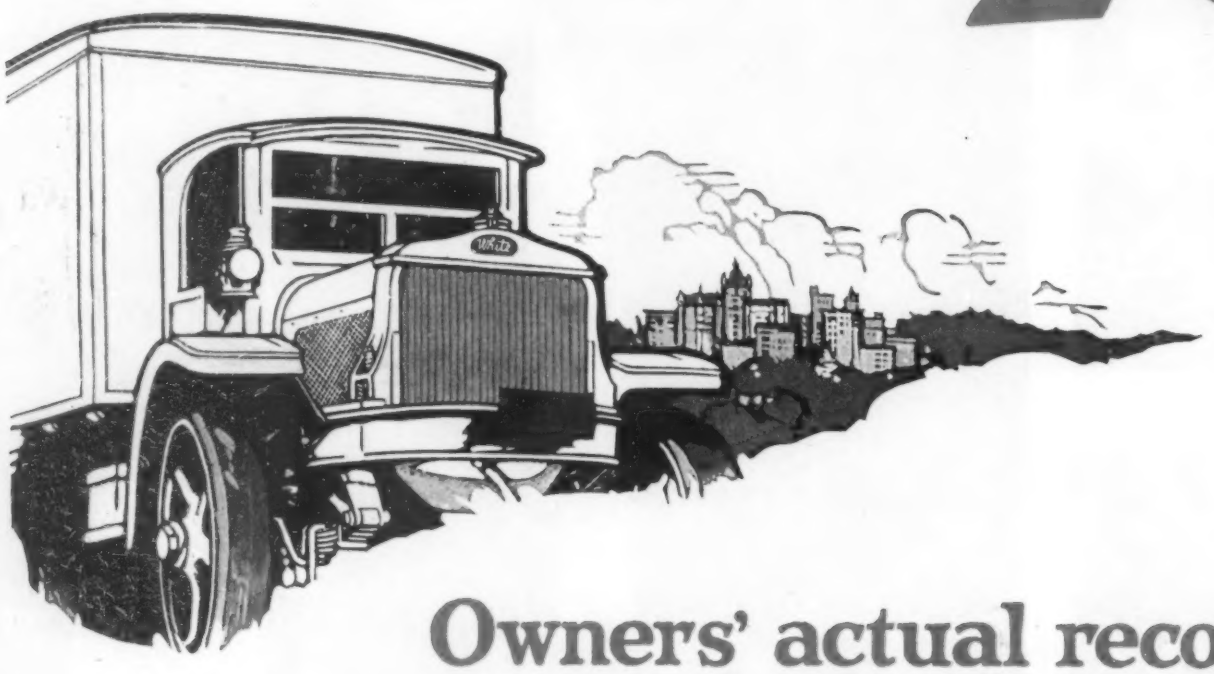


THE FULL-BLOWN AMORPHOPHALLUS TITANUM

The flower is now forty days old and is eight feet high. Three days later the flower collapsed

The upper left-hand illustration shows the curious flower known as *amorphophallus titanum*. It was only about nineteen inches high after twenty-two days of life, but twelve days later it was four feet, four inches high and the bud had opened. Our large illustration shows the full-grown flower, forty days old. It was then eight feet high and is shown unfolding its bell-shaped spathe that closed three days later. The scent of this flower is described as "evil."

100,000
200,



Owners' actual records of White Truck mileage

336 Whites have run **300,000** miles and more each

759 have run between **200,000** and **300,000** miles each

1204 have run between **150,000** and **200,000** miles each

3720 have run between **100,000** and **150,000** miles each

giving us the astounding total, by owners' actual records —

6019 Whites have run **100,000** miles and more each

100,000 miles is four times around the world.

You would have to go from New York to San Francisco and return 16 times by rail before you would exceed 100,000 miles of travel.

There is a White Truck model to meet every transportation need. Truck chassis, $2,150 to $4,500; Model 50A Bus chassis, $4,950.

The names of all of the owners of the 6,019 White Trucks which have made these great mileage records are listed in a 100,000-mile booklet, published annually. You will find owners in your own section of the country, in your own line of business. Write for it. We will gladly send it to you—free.

WHITE

,000 300,000 miles and more

No truck owner will operate a truck long enough to run 100,000 miles unless those miles are *money earning miles*

Once more the owners of White Trucks report from their actual records a volume of high truck mileages that has no parallel.

More than 6,000 Whites, whose owners actually check and report mileages, have run 100,000 miles and more each. We have no accurate record of the hundreds of additional Whites which have exceeded 100,000 miles. We do not count them.

A high-grade motor truck *should run* 100,000 miles. Whites *do*. Isolated performances of one truck, or even one hundred, are not performance standards. Hundreds of White Trucks, as far back as 1917, had set the 100,000-mile standard of measure for motor truck performance. And, while thousands of them have been reaching that mark, other Whites have gone on—doubling, trebling, quadrupling it.

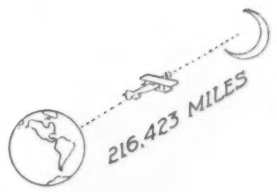
More than 300 have passed the 300,000-mile mark and are still giving dependable service. Many have exceeded 500,000 miles.

Some 100,000-mile White owners have only a single truck. Some have as high as twenty or thirty in their White fleets that have each delivered 100,000 and more *money-earning miles*. Some Whites have achieved 100,000 miles in a few years. Others have required 10 years to run that distance. Still others, serving their owners with equal dependability and profit for 14 and 15 years, have not yet reached 100,000 miles.

But White Trucks in all sections of the world—all models, in all lines of business—have contributed to this record. Mountain grade and desert sand, clinging mud and frozen ruts, broken city streets and untracked wilderness—through all kinds of going Whites have carried their pay loads over their hundreds of thousands of miles in all weathers, climates and altitudes.

We could offer no stronger proof that White Trucks give you more sustained, continuous, profit-making transportation than any other motor truck you can buy.

No other truck manufacturer has ever published such a volume of evidence of dependability, economy and long life. No other truck manufacturer can.



200,000 miles is almost as far as the distance to the moon—216,423 miles.

200,000 miles is more than 50 times the distance between New York and London.

UNITED STATES RAILROADS

300,000 miles is more than the total mileage of all the railroads in the United States.

THE WHITE COMPANY
CLEVELAND

TRUCKS

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

A razor blade in a handle is useful to cut clippings with

Making the Safety Razor Blade Do Double Duty

WE have carried for some time a little pocket knife which is shown in detail at the top of the page. The pivoted holder serves to hold an old safety razor blade which shuts into the handle of the knife, making it safe to carry. We use this knife to cut clippings from newspapers and find it very efficient. The circular describing this knife says plaintively: "Being of the refined pocket-knife family, you must not expect me to serve as a screw-driver, can opener, nail puller or to punch holes with." It is also an excellent cigar cutter.

A handy fish scaler for the disciple of Izaak Walton

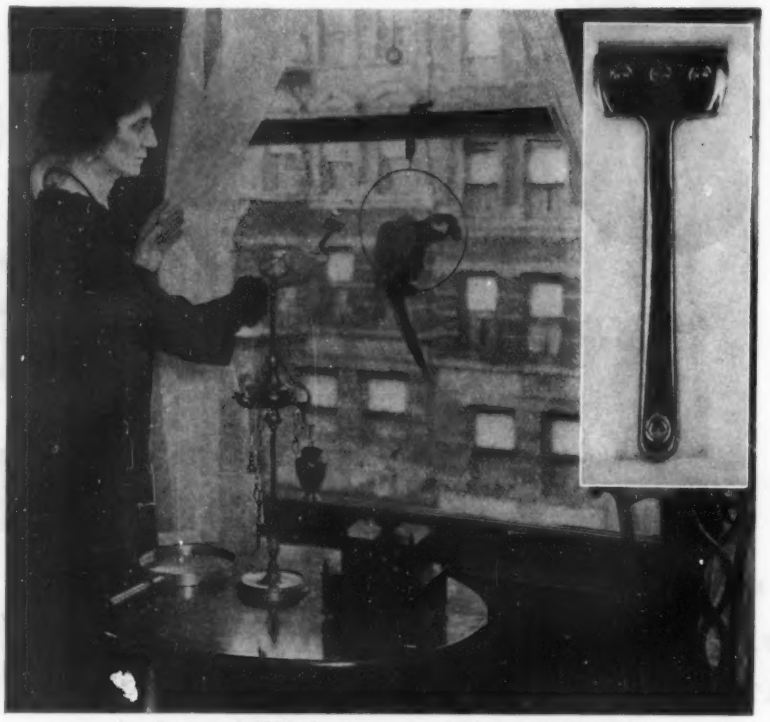
Putting the Old Razor Blade to Work

WE have illustrated from time to time many holders for razor blades that have lost their usefulness for shaving purposes. The one being demonstrated by the little girl in the illustration is one of many types. She is shown as ripping a seam and the inset shows how the razor blade is attached to the handle. There is a screw in the center which holds the blade securely. The use of such blades in practical holders is unlimited.

Swivel-Jointed Soldering Iron for Work in Tight Places

THE advent of home-made radio sets and the necessity of soldering in tight places has brought about the swivel-jointed soldering iron shown in the illustration on this page. The copper tip, it will be noted, is provided with a ball-and-socket joint, so that it may be bent at any angle with reference to the main part of the iron which contains the heating element.

A swivel tipped soldering iron for the radio fan



A safety-razor blade becomes an excellent paint scraper

Scraping Off the Scales

CAMPING and fishing days are coming in the spring. A new and better fish scaler is ready now for lovers of this sport. The handle is somewhat elevated, making a better leverage on the fish itself.

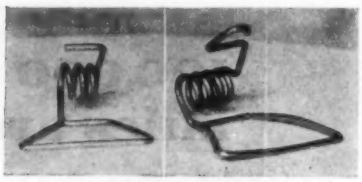
A Firm Holder for the Razor Blade

THIS page is largely given up to the utilization of safety razor blades. The device shown is a sturdy holder which secures the blade firmly through its three holes

A razor-blade holder of manifold uses

Another razor knife

by a screw and two studs. One of the uses of this improvised tool is to remove specks of paint from the window and it is so demonstrated. The inset shows the blade and holder in detail.



A wire holder for ordinary and electric irons

A Stand for Irons

A STAND for irons, both electrical and the ordinary iron. Prevents irons from falling and the burning of the ironing cloth on the board. Easily attached to any iron not provided with means for making it stand upright.

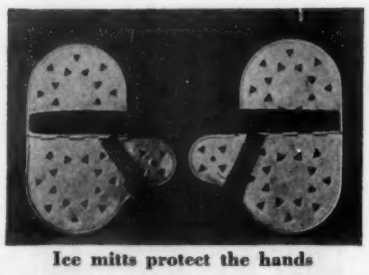
The Razor Knife

RAZOR blades cause nasty cuts unless held in practical holders like those shown on this page. The device illustrated in the upper right-hand column resembles the one shown on the left, but is a less expensive article. It is made with and without a cigar clipper-hole. The construction is clearly shown in the illustration.

Making One Electric Light Socket Do the Work of Four

THE illustration here shows a convenient table device which affords four connections from the usual electric light socket or electric outlet. As will be noted, there are four pairs of slots which take the usual parallel-blade attachment plug. This device is intended for use on any table, where more than one electrical appliance is to be used. The case of this device is of porcelain, while the contact-making members consist of heavy spiral springs concentrically arranged and aligned with the four pair of slots.

A multiple electric outlet



Ice mitts protect the hands

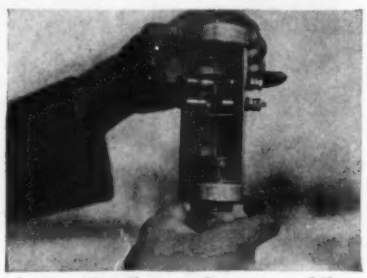
A Highway Crossing Barrier for Automobiles

THE barrier is constructed of two upright structural steel columns, bridged together at the top and firmly anchored in concrete at their bases. Suspended between these columns are three lengths of steel cables which are lowered in the path of the motorists at the approach of a train.

Squares of heavy canvas, painted with diagonal stripes of black and white, are stretched between these cables. At the top of the barrier is a large gong which is used as a warning signal, and a sign bearing the word "stop" in large, ruby-red letters.

A whiplash is placed two hundred feet from the center of the tracks at the crossing and acts as a warning which it is impossible for the motorist to overlook. It consists of a horizontal bar which swings out over the highway at the approach of a train. From this horizontal bar are suspended ten whip-like strips of cable which are covered with short lengths of bamboo.

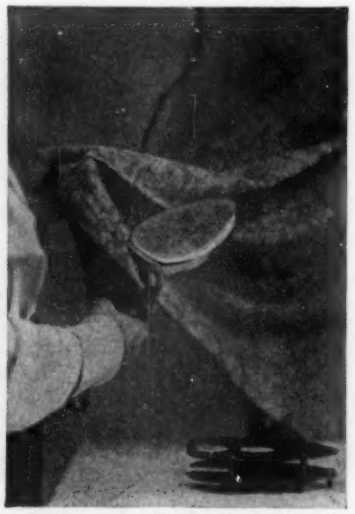
When a train reaches a point a mile from the crossing the whiplash is set in motion and four seconds later the barrier starts slowly down, thus closing the road.



Automatic oil gage for automobiles

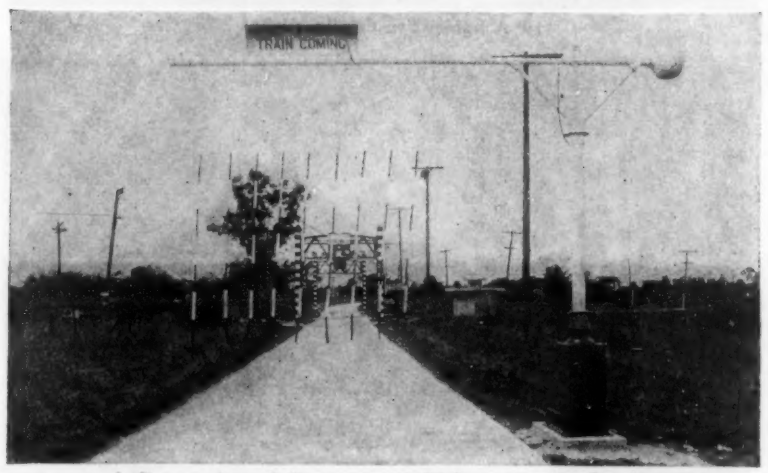
An Automobile Oil Gage

THE automatic oil gage illustrated here is attached to the drain plug in the crank case of the engine and is electrically connected with a dashlight signal and the engine. When more oil is required the gage, acting through a series of floats, makes an electric contact which lights a red bulb on the dash. This red light burns continuously until more oil is added and this new oil level raises the float so that the electric contact is broken. If the oil level drops further the gage stops the motor.



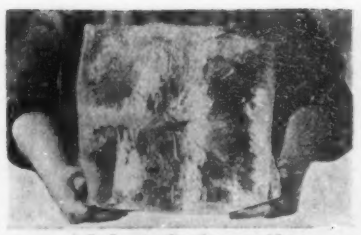
Doing away with the ironing board

Automatic skirt marker for dressmakers and tailors



A distant view of the automatic highway-crossing barrier

A close-up view of the barrier



A help to the housewife

Ice Mitts Afford Comfort for the Housewife

WE all know how easy it is to drop a chunk of ice and how hard it is to hold it with a dish towel. These mitts which cost only twenty-five cents, prevent slipping and enable the housewife to put the ice in the refrigerator with comfort.

An Invention for the Dressmaker

DRESSMAKERS seldom have things invented to help them, but here is one that will be appreciated by modistes and tailors. The measuring stick carries an adjustable marker which can be regulated to any height and marks with accuracy any material. The marking powder does not stain and can be easily rubbed off.

Thread Cutting Thimble

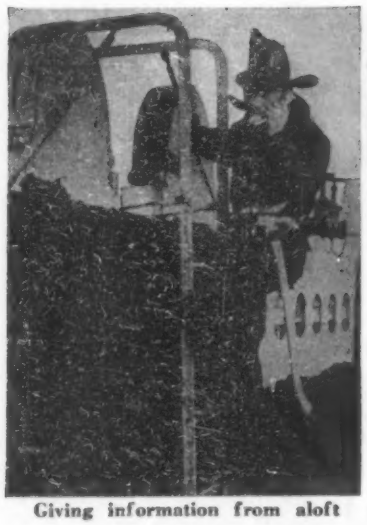
THE illustration below shows a novel invention in the way of a thread cutting thimble. The busy housewife need not bother with the awkward shears while doing her sewing. Simply insert the thread in the little groove and pull on it and the job is done.

A thimble that cuts thread

An Electric Iron of Universal Application

THE iron illustrated was developed to enable ladies while traveling to have a simple, compact iron with which to keep their dresses pressed with a minimum of effort. The iron is small, and is provided with a pivoted handle which can be adjusted so as to permit the iron to be mounted on a simple, light stand so that fabrics can be pressed out. Both hands may be utilized to hold the fabric without having to hold the iron at all, the fabric being moved by the hands over the iron surface.

Passing material over the iron



Giving information from aloft

A Telephone for the Fire Fighters

FIRE CHIEF THOMAS F. MURPHY, of San Francisco, has been testing a telephone system for use at fires which has proved very efficient. Firemen going aloft carry a combined transmitter and receiver. A wire is dropped to the street so that connection is made with the instrument of the officer in charge. The batteries are in a case.

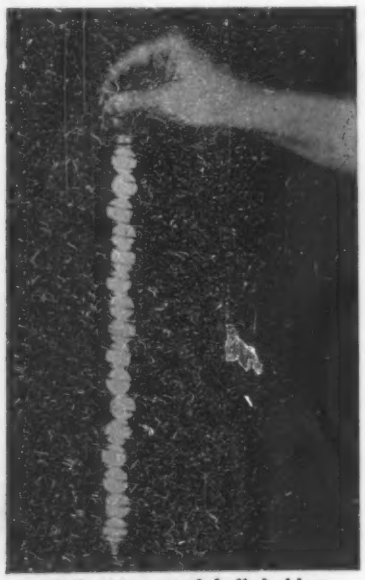
A Third Hand in the Dark

THE flashlight holder illustrated is capable of many uses, one of which is to cast a light on dark corners of the radio outfit. The holder folds up when not in use.

Flower pot and jardiniere

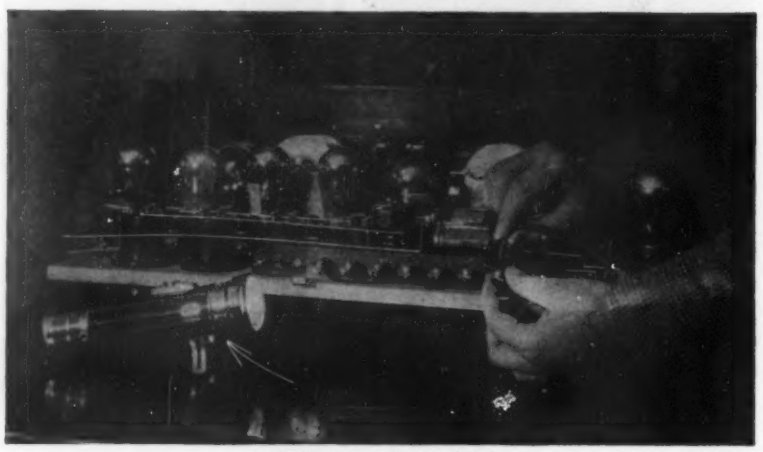
A Flower Pot That is Different

ON the combination flower pot and jardiniere illustrated, the three cups, one of which the hand points to, have air vents to the roots. They also serve to catch all surplus water, making it unnecessary to place a saucer to catch water.

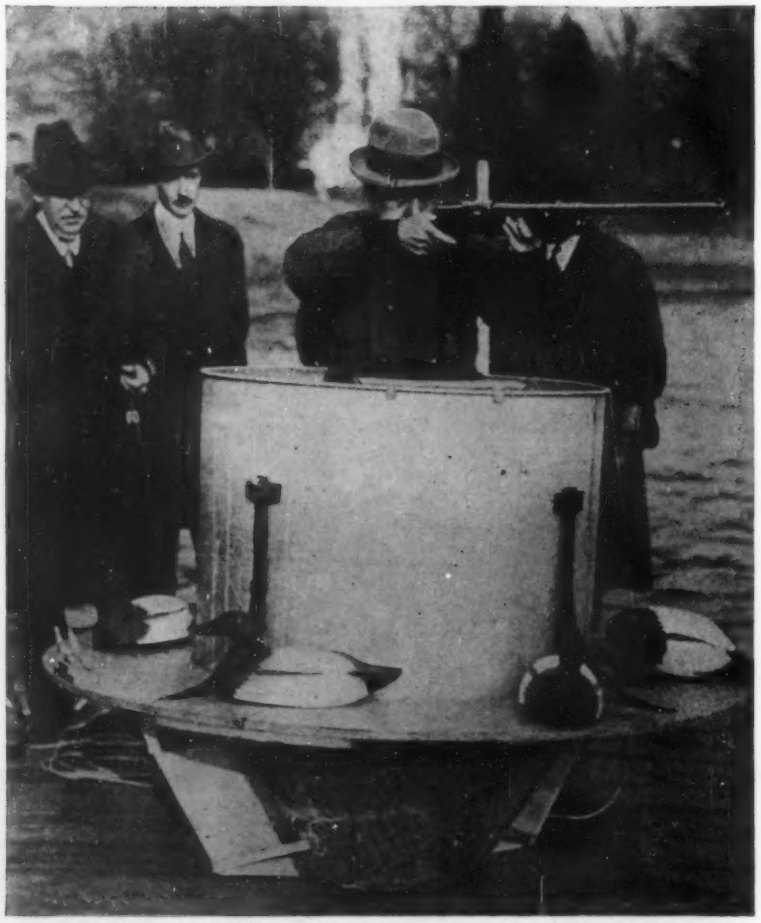


Coil-spring moth-ball holder

A home-made motorcycle for the ice



A holder for the flashlight



Life raft and duck blind. This was invented by Dr. Charles Hunt of Washington

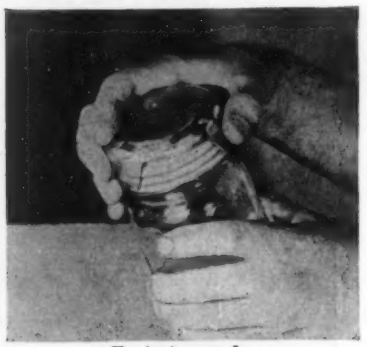
The ground end of the fire-fighters' telephone

Sport on the Ice

THE device illustrated is a home-made affair, and there is little to say about it. The actual driving mechanism is a leather belt studded with steel points.

A Convenient Holder for Moth Balls

THESE holders resemble a bird-cage spring. The moth balls are put through the top and a movable cover prevents their loss if the spring is dropped.



Fruit jar sealer

Fruit Jar Sealer

ROUGH and uneven edges on the tops may be straightened out perfectly and old tops may be used again for canning. This sealer will also make the top air-tight by pressing it firmly against the rubber.

Every Cigar Box Its Own Humidor

IF the smoker's cigars are too dry, he has only to lift the lid, turn down the front, then moisten the blotter and close up the box. If the cigars are too moist, open the lid, and lower both front sections.

An inexpensive humidor built in the box

Recently Patented Inventions

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT.—The invention provides means for raising an aircraft vertically to a desired altitude and then driving it ahead. Patent 1547434. J. Michaud, Box 971, Watsonville, Calif.

AIRSHIP.—Embodying advantages of the lighter than air class, the speed and rigidity of the heavier than air craft, and possessing safety attributes. Patent 1550797. O. Geisler, 6947 Peoria St., Chicago, Ill.

STABILIZER FOR AIRSHIPS.—By means of which ballast, under manual control from the pilot house, is moved to maintain the ship on an even keel. Patent 1550798. O. Geisler, 6947 Peoria St., Chicago, Ill.

Pertaining to Apparel

SLIP.—Wherein a neat fitting garment is presented with a minimum of parts, the upper part fitting adjacent the waistline, the lower part shadowproof. Patent 1547961. Mildred C. Schmolze, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

GARMENT.—In the form of overalls, of simple construction, employing as few buttons as possible, and those removable, to facilitate washing. Patent 1547457. B. C. Smith, 32 Parsons St., San Francisco, Calif.

Electrical Devices

ELECTRIC CONTROL.—Adapted to be automatically operated, for causing in proper sequence, the starting and stopping of a phonograph mechanism. Patent 1547259. T. E. Niblock and G. O. Miller, 216 16th St. No., Great Falls, Mont.

PROPAGANDA APPARATUS APPLICABLE TO ELECTRICAL FANS OR MOTORS.—The device consists of a number of transparent disks painted to constitute an advertisement, some electric bulbs, and a drum or cover. Patent 1547864. E. R. Etcheto, Buenos Aires, Argentina.

WIRELESS TELEGRAPH APPARATUS.—Which provides means for rendering the telephones in the apparatus inoperative while the key is depressed in transmitting position. Patent 1547215. H. E. Hallborg and H. R. Miller, c/o H. E. Hallborg, 66 Broad St., New York, N. Y.

ELECTRICAL INSULATOR BLOCK.—Which is the same thickness as the plaster and may be applied to a partition in wiring a building. Patent 1548715. A. A. Dennis, 344 West St., Ashtabula, Ohio.

VARIABLE CONDENSER.—Designed particularly for use in connection with radio receiving sets, but adapted for general purposes. Patent 1547412. R. Crocker, Box 324, Winlock, Wash.

INCANDESCENT LAMP.—Which may be used a relatively long period without renewing the filaments therein. Patent 1551463. C. K. Brown, Box 390, Penticton, B. C., Canada.

Of General Interest

MONEY BELT.—Bandit-proof money belt for payroll clerks and bank messengers. Device to insure safe transfer of money to and from banking institutions. Patent 1536965. Benjamin Ocker, Marion, Pa.

LATCH FOR THE FRAME JAWS OF PURSES, HAND BAGS OR THE LIKE.—Which relieves the frame jaws and hinged connection from any strain which would tend to weaken the same. Patent 1543577. E. Kuhn, 111 E. 96th St., New York, N. Y.

PUZZLE.—In which skill is required to maintain certain elements in position, while others are being moved to desired position. Patent 1543600. D. T. Clark, 54 No. 17th St., East Orange, N. J.

BUTTON CLAMP.—For use in connection with button-sewing machines, automatically positioning the button. Patent 1543592. W. Belsky, c/o Victor Nekarda, 230 5th Ave., New York.

News for Inventors

A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights

Conducted by Milton Wright

Cannot Stop Rotary

WHEN Gallaher, Limited, of Belfast, Ireland, sought recently under the act of 1920 to register the word "Rotary" as a trademark for tobacco, cigars and cigarettes, there naturally was a protest, for the famous Rotary clubs had nothing to do with his tobacco products.

Nevertheless, Gallaher is entitled to register the mark, First Assistant Patent Commissioner Kinnan holds. He bases his decision on the ground that the tobacconist had filed a certificate showing registration and use of the mark in Great Britain prior to the date of incorporation by the Rotary clubs.

"It is believed," he says, "that the registration in England by the applicant entitles it to registration in this country." Use of the mark in the United States he holds to be unnecessary where the applicant is domiciled in a foreign country.

An Invention with Teeth

"NOW among all the benefits that could be conferred upon mankind, I discovered none so great as the discovery of new arts for the bettering of human life," said Lord Bacon in his "Novum Organum." And what particular art could better human life more than dentistry, thinks the average aging human.

It is a fact that dentists are among the prolific inventors. A recent noteworthy invention in the field is that of Dr. Edward L. Dillman, of Jamaica, New York, who recently patented a process for making porcelain plates. Hitherto plates of rubber or aluminum have been the only ones that a poor man with ailing teeth could afford, although admittedly neither material is as satisfactory as porcelain.

Dr. Dillman has succeeded in perfecting a porcelain plate without the usual platinum base, which shrinks only eight percent in the making and which may be produced without difficulty. It promises to bring the price of a porcelain plate down substantially nearer the present price of the less satisfactory rubber one.

That there is a demand for such a plate is evidenced by the fact that, when the inventor recently used a small advertisement offering to teach dentists how to make it, more than 200 responded by the first mail. Here is a case where an art has been looking eagerly for a needed improvement.

Why the Delay?

"WHY does it take so long for a patent to issue?" is a question asked by many an inventor. The usual answer is, "Because the Patent Office has too few men and too little money to catch up with the ever increasing number of applications from inventors." Donald H. Sweet, however, writing in the Journal of the Patent Office Society, has a new explanation.

"A large proportion, say more than half, of the applications pending," he says, speaking of patent applications in general, but especially of those where there is protracted interference legislation, "are the properties of parties that do not desire the issued patent as a basis for negotiation or for carrying on business.

"The longer before their patents issue, the better for them, for three reasons: first, the monopoly will end at a later date; second, while the application is pending, some competitor may bring out a device seen upon analysis to be an infringement of certain features of the invention that might not have been claimed even by the most painstaking and diligent counsel, without an inspection and analysis of the competing device to guide the prosecution; and third, a direct result of the second consideration, as long as the application is still pending it is often better protection from the practical point of view than the issued patent."

By way of remedy he suggests that the patent be made to run from the date of filing the application, rather than from the date of the issued patent, and raising a liability for infringement as soon as patentability has been adjudicated, independent of any delay in the determination of priority.

A Secret That Leaked

HERE is an actual conversation which took place between the editor of this department and the president of a well-known company which lays a novel form of flooring in large buildings.

"Here is a floor covering I invented," said the president. "It is a distinct improvement over anything that was used before and it has ingredients that we were the first to use in such a product. Can I get a patent on it?"

"How long have you been installing floors with that material?" we asked him.

"About seven years."

"Why did you not apply for a patent long ago?"

"We did not think it necessary. Nobody else knew how to produce this kind of flooring. It was a secret process. Why make it public?

"Why do you want a patent now?"

"Well, the secret leaked out. Our principal competitor is now turning out the same product and is cutting his price to the bone. We originated the flooring material and we want to stop him, if possible, from stealing our thunder."

"Can you prove that some employee violated your confidence?"

"We know how it happened. One of our men, soon after leaving our employ, moved to the same street as the manager of our competitor's factory. Soon afterwards the competitor began to put out the same product as we do and to underbid us on contracts. Unfortunately, we cannot prove that he gave away our secret formula. But isn't there something we can do to protect our rights."

"There isn't a thing you can do. You have no rights."

This man's experience is not unusual. A manufacturer can choose between secrecy and patent protection; he cannot have both.

LUSTROUS FABRIC FOR DECORATIVE PURPOSES.—Which is strong and durable, will retain its luster and can be handled without losing its shape. Patent 1543634. S. B. Wertheimer, 19 W. 24th St., New York, N. Y.

BUILDING BLOCK.—With which is embedded a reinforcing element so formed and arranged as to impart a maximum strength. Patent 1544478. M. D. Payne, 460 No. 11th St., Newark, N. J.

HORN AND AMPLIFIER FOR SOUND-RECORDING AND SOUND-REPRODUCING APPARATUS.—So constructed that there is a space between the casing and the horn, which contains a substance forming a damper. Patent 1544,460. G. Lakhovsky, 5 Ave. du Bois-de-Boulogne, Paris, France.

DRAINER FOR SINKS.—Which may be conveniently adjusted in a sink in close proximity to a dish-pan. Patent 1544430. M. B. Brown, 63 Gates Ave., Brooklyn, N. Y.

CAN.—For the reception of liquids, having a flexible tubular discharge member, which when secured to the can top forms a handle. Patent 1544503. V. W. Thomson, 826 3rd St., Portsmouth, Ohio.

BACK BRACE.—Which will prevent strain of the back muscles of a wearer, when stooping to pick up objects. Patent 1544162. A. J. La Vigne, 5886 Lafayette Block, Detroit, Mich.

FILM GRIPPER AND HOLDER.—For use by photographers in printing from films, to prevent shifting or curling of the film. Patent 1544139. G. Duclos, R. F. D. No. 2, Box 106, Manchester, N. H.

PERFUME VAPORIZER.—Of attractive and ornamental appearance, especially designed for use in theatres and public buildings. Patent 1544212. J. G. Blaschke, 110 Woodbine St., Hot Springs, Ark.

FOLDING COT.—For use by campers, automobile tourists or persons requiring a comfortable cot, which may be folded into a small bundle. Patent 1544140. B. B. Dudley, Visalia, Calif.

TOOTHBRUSH ATTACHMENT.—By means of which the brush may be utilized for thoroughly and quickly cleaning plates of false teeth. Patent 1544404. W. L. Hummel, 2911 N. Richmond St., Chicago, Ill.

REFRIGERATOR.—Having means for stopping the circulation of cooled air from the ice compartment when the door of the food compartment is opened. Patent 1544403. W. L. Hummel, 2911 N. Richmond St., Chicago, Ill.

GRAPHIC CHART.—Adapted for use in various industries, to visibly denote the relation of one series of things to another. Patent 1544182. H. W. Ricks, 268 E. 43rd St., Los Angeles, Calif.

SAFETY RAZOR.—Provided with a container for liquid to be delivered in close proximity to the blade during the shaving operation. Patent 1544112. E. Q. Sullivan, Box 641, San Bernardino, Calif.

FRUIT DRIER.—Provided with metal trays, having wire netting bottoms, whereby their manipulation within the drier is facilitated, and the fruit protected. Patent 1545185. O. W. Hancock, Elkton, Oregon.

SIPHON.—Primarily for use in decanting clear cane juice in the manufacture of sugar, but adapted for separating liquid from a sediment. Patent 1544640. J. G. Gibbs, 412 Whitney Bldg., New Orleans, La.

FOLDING SICK-ROOM TABLE.—So constructed that the top may be presented over the bed for conveniently holding articles. Patent 1544935. E. J. Preston, Paradise, Calif.

EYEGLASSES.—In which the lens mounting is hingedly connected with the frame, and may be swung out of the line of vision when desired. Patent 1545281. L. Royak, 522 E. 78th St., New York, N. Y.

WINDOW.—So constructed that it will effectively prevent the ingress of air and dust when the sashes are closed. Patent 1545453.

J. Polachek, J. Jepsen and E. Peremi, c/o J. Polachek Bronze & Iron Co., 476 Hancock St., Long Island City, N. Y.

CLASP.—For use with belts or similar articles, which it is practically impossible to accidentally disconnect. Patent 1545389. H. Barnowitz, 1036 DeKalb Ave., Brooklyn, N. Y.

SLED ATTACHMENT.—Relating to means for controlling the movement of either the steering or braking action of a sled. Patent 1545442. J. W. Novak, 3358 W. 88th St., Cleveland, Ohio.

CONDENSER FOR LIQUID-STORAGE TANKS.—Capable of absorbing and condensing the vapors emanating from volatile oils, and eliminating the use of vent pipes. Patent 1545352. E. J. Rodriguez, 145 Park Row, New Orleans, La.

SHADE OR BOWL AND METHOD OF MANUFACTURING SAME.—Of fibrous material for use in ceiling fixtures, lamps and other purposes where glass, paper or vellum have been used. Patent 1545369. A. J. Tizley, c/o E. F. Caldwell & Co., 38 W. 15th St., New York, N. Y.

FENCE.—Constructed with a fender to prevent horses and cattle from approaching the fence proper, or leaning over or bending the same. Patent 1546094. F. M. Marbaugh, Monroe, Ind.

MATRIX HOLDER.—Formed from a single piece of metal, may be quickly picked up and is instantly in operative position. Patent 1545994. R. E. Anderson, 35 Washington St., Lancaster, Pa.

VANITY CASE.—Which will function with equal facility either with powder or compact, the receptacle being removably held. Patent 1546239. S. A. Jaroslawski-Fioret, c/o Fioret, Inc., 677 Fifth Ave., New York.

BURGLAR ALARM.—For sounding an alarm when a door or window is opened, is compact, and may be carried by travelers. Patent 1545947. W. W. Davies, Louisville Trust Bldg., Louisville, Ky.

METHOD OF MANUFACTURE OF ARTIFICIAL PEARLS AND MOTHER-OF-PEARL.—By the precipitation of an alkaline earth hyposulphite and the incorporation of pearl essence into a plastic substance. Patent 1546309. J. Paissenu, c/o C. Bletry, 2 Blvd. de Strasbourg, Paris, France.

CAN TOP.—Perfectly airtight, readily removable, and constituting a window through which the contents of the can are visible. Patent 1547080. E. F. Swan, 14 Bolton Rd., Pelham Manor, N. Y.

COMPRESSOR FOR REFRIGERATING APPARATUS.—Whereby the connection between the main and auxiliary chambers is automatically cut off upon a definite reduction of pressure in the liquid therein. Patent 1547066. W. Nuss, St. Mary's Hospital, Hoboken, N. J.

GLASS FLOAT.—For use in or connection with flushing tanks, controlling the inflow or outflow of the liquid. Patent 1547052. J. A. Larson, c/o Pierie R. Falk, 30 Gay St., Elmhurst, N. Y.

CLUB.—For striking a ball or other projectible objects, and protecting the club shaft and ball from wear or splitting. Patent 1547075. R. E. Smither, 1800 E. 93d St., Cleveland, Ohio.

DISPENSING CONTAINER.—Adapted for dispensing granular substances, such as sugar, in regular quantities without uncovering the container. Patent 1546468. C. L. Bernier, 4034 Fourth Ave., Detroit, Mich.

CAN FOR FREEZING ICE.—In such manner that blocks can be formed in less time and at less expense than with cans in common use. Patent 1547700. R. Winfree, R. No. 3, Salisbury, Missouri.

HYDRANT.—For controlling a flow of water, and directing it through any or all of several passages. Patent 1547248. H. P. Wheeler, 1200 Cairo St., Springfield, Mo.

CONCRETE BUILDING FORM.—Which may be readily changed from one position to another in the construction of a wall. Patent 1547221. C. R. Lehrack, 1622 Cypress Ave., Kansas City, Mo.

PAIL-SUPPORTING TRUCK.—For permitting a pail or bucket to be moved from place to place without the necessity of lifting. Patent 1547914. J. P. Herrick, Society of Savings Bldg., Cleveland, O.

VALVE FOR GASES.—Which is operable to permit the passage of air, gas or similar fluids therethrough in one direction only. Patent 1547974. J. C. Thaw, The Plaza Hotel, New York, N. Y.

LUMINOUS DIAL OR INDICATOR.—Especially adapted for use on automatic telephones although possessing a general utility in many various arts. Patent 1546557. A. V. Smith, c/o C. R. Morris, 3969 Westminster St., St. Louis, Mo.

SOUND AMPLIFIER.—Especially adapted for use in connection with radio apparatus, directing the waves in a horizontal plane. Patent 1547535. M. Van Blaricom and W. Le Blanc, c/o M. Van Blaricom, Montclair, N. J.

ANIMATED DISPLAY DEVICE.—For use with amusement and advertising appliances, for simulating the natural movements of the legs of an animal or human being. Patent 1547899. E. F. and C. P. Chester, c/o Chester Pollard Amusement Co., 1416 Broadway (R. 602), New York, N. Y.

DEVICE FOR PRODUCING GROUND-GLASS EFFECT ON FILMS.—Which constitutes a frame for clamping the film firmly before flowing the frosting fluid on the back of the film. Patent 1547945. L. Mustapich, Opuzen, Dalmacipa, Yugoslavia.

WINDOW LOCK.—For locking the upper or lower sashes against relative movement either in closed or partially open position. Patent 1547906. W. A. Cross, c/o Roth, 545 W. 144th St., New York, N. Y.

TROLLING SPOON.—Having novel means for attaching an artificial lure thereto so that it will be clearly discernible from both sides. Patent 1546673. S. Poulsen, 1942 So. Market St., San Francisco, Calif.

SAFETY LOCK.—Adapted for securing containers of every character, in such manner that any attempt to gain access will be indicated. Patent 1548453. S. A. Garcia, c/o Ancora Safety Seal & Lock Co., 366 Madison Ave., New York, N. Y.

DISPLAY BOX.—Constructed to be supported in an inclined position upon a counter, or other display surface. Patent 1548254. P. H. Casey, 500 No. Fremont Ave., Baltimore, Md.

VENTILATOR.—Which will constitute a portion of a window or sash, and will be air and water-tight when closed. Patent 1548770. E. Tietze and G. Schuler, 521 St. Anns Ave., corner 148th St., New York, N. Y.

GLASS-PANE-COUPLING DEVICE.—For securing two panes at an angle to each other, and insuring a perfectly tight coupling capable of adjustment. Patent 1548706. L. H. Broome, 33 Greenwood Ave., Jersey City, N. J.

CONDIMENT HOLDER.—For condiments such as pepper and salt, with means connected with the cover for selectively sifting the condiments therefrom. Patent 1548684. S. Henigson, 15 E. 40th St., New York, N. Y.

SELF-INKING HAND STAMP.—With an inking pad that will automatically resume its place, yet may be readily removed by a slight pressure. Patent 1547410. F. Childs, 571 McAllister St., San Francisco, Calif.

Hardware and Tools

DEVICE FOR TRIMMING SOD.—By means of which the sod at the edge of a sidewalk may be trimmed a V-shaped furrow. Patent 1543996. W. L. Franks, 824 E. 25th St., Indianapolis, Ind.

WINDOW LOCK.—For locking the sashes in fixed relation, allowing the window to be open as predetermined, without possible change from the outside. Patent 1543156. A. T. Gibson, 409A Hawthorne Ave., Oakland, Calif.

GEARED DRILL BRACE.—With control for changing the gear ratio or speed rotation of the drill. Patent 1544168. W. E. Nolan, 90 St. Marys Ave., San Francisco, Calif.

COMBINED TESTING PUMP AND GAUGE.—Which may be readily carried about, for use in testing plumbing and gas installations. Patent 1543989. L. Deck, Box 650, Shreveport, La.

COMBINED CASING AND TOOL SPEAR.—Having means for holding the slips positively although releasably in their inactive positions, while the spear is being lowered in a well casing. Patent 1544009. M. W. Jones and B. H. Brush, c/o Jones Everett Machine Co., Ardmore, Okla.

WIRE STRETCHER.—Which is simple and durable, though of light weight construction, easily operated to properly tension the wire. Patent 1545325. E. Hess, Brook, Ind.

SAW TOOTH.—For use in stone-cutting apparatus, whereby the cutting action is more efficient by reason of a plurality of cutting surfaces. Patent 1545448. W. H. B. Perry, c/o Perry Granite Corp., Waterbury, Vt.

SAFETY-RAZOR-BLADE HOLDER.—Which will support blades of the Ever-ready or Gem type during honing and stropping. Patent 1545388. F. Barnofsky, Box 209, Nome, Territory of Alaska.

SETTING TOOL FOR CORRUGATED FASTENERS.—Which is magnetized to retain the metal fastener in proper position and prevent accidental displacement until the driving has been completed. Patent 1546296. A. A. Lundeen, 2 Calvin St., Lynbrook, L. I., N. Y.

DOOR JACK.—For use in steadying a door while putting on a lock, or for holding the door at a desired angle. Patent 1545532. E. D. Stubbs, 588 Gratiot Ave., Detroit, Mich.

METAL BINDING STRIP.—Which affords facilities for quickly securing fabric to a frame so that the fabric will be prevented from slipping. Patent 1546734. F. DE W. Jacobs, Box 642, El Centro, Calif.

GLASS CUTTER.—Constructed with a grip device adapted to go around the finger to prevent the swerving or twisting of the cutter. Patent 1547451. G. T. Scott, Susanville, Calif.

LOCK NUT.—Which has facilities for engaging with the shank of a bolt to lock the nut firmly, although releasably. Patent 1547983. E. G. Weaver, 110 So. Idaho St., Butte, Mont.

TOOL JOINT.—For the rotary drill stems of well drilling machinery, relieving the threads of heavy strain. Patent 1547759. W. O. Journeay, 2810 Bagly St., Houston, Texas.

WRENCH.—In which the jaws may be readily adjusted, and firmly held in proper engagement with work of various sizes. Patent 1547198. L. Braden, Burney, Calif.

COTTER PIN.—Having all the advantages of the conventional cotter pin but which facilitates the insertion and removal. Patent 1548688. B. J. Johnson, 465 Logan St., Bridgeport, Conn.

CLAMP.—Wherein the movable jaw is adjusted by means of a screw in such manner that no twisting action will be applied to the work. Patent 1549567. L. A. Baldwin, R. D. No. 1, Boonton, N. J.

JEWEL-PIN SETTER.—So constructed that jewel pins may be accurately and quickly set in watch rollers. Patent 1549129. P. E. Calame, Holly Springs, Miss.

MARKER.—A tool for use by carpenters in marking face and edges of boards to be fitted against abutting boards. Patent 1548421. C. B. McCallum, 160 E. 14th St., Oakland, Calif.

BONE SAW.—Particularly adapted for retail butchers, for quickly sawing bones in meat being cut. Patent 1550520. W. J. Drucker, 9110 St. Charles Court, Woodhaven, L. I., N. Y.

LOCK VALVE.—For preventing unauthorized manipulation of a valve by locking the stem. Patent 1550487. J. A. Barnes, Box 631, Burkburnett, Texas.

CLAMP.—By means of which the ends of a pair of pipes may be rigidly locked, so that they may be welded. Patent 1550161. E. W. Hamm and D. B. Schull, c/o R. E. Masterson, 441 Keith Bldg., Beaumont, Texas.

LAZY TONGS.—Especially adapted for taking out clinkers from grates of furnaces, stoves and the like. Patent 1549836. A. Hopp, 8127 Jeffery Ave., Chicago, Ill.

WRENCH.—Wherein the jaws are capable of a wide range of adjustment and require but one hand in their manipulation. Patent 1551085. E. R. Carpenter, 303 Am. Natl. Bank Bldg., Oklahoma City, Okla.

MAGAZINE TACK HAMMER.—Adapted to store a plurality of U-shaped tacks, with a mechanism for automatically feeding the tacks. Patent 1550932. D. C. Todd, Box 425, Spartanburg, S. C.

Heating and Lighting

HEATER.—Primarily for heating water, the heater being easily taken apart for cleaning and assembled without danger of leakage. Patent 1547986. E. G. Whitacre, c/o Whitacre Boiler Co., Wellsville, Ohio.

OIL BURNER.—In which the fuel is fed thereto under pressure, and is discharged with a swirling or rotary motion. Patent 1548719. J. P. Lewis, c/o Moore, 2439 Coney Island Ave., Brooklyn, N. Y.

DAMPER REGULATOR.—Whereby the consumption of fuel and the temperature of the furnace may be maintained at the desired degree. Patent 1549653. J. M. Corson, 362 86th St., Brooklyn, N. Y.

WATER HEATER.—Designed to heat water during its passage from the water main, or other supply, to its discharge point. Patent 1550529. H. C. Flacke, Sr., 1325 Jefferson Ave., Buffalo, N. Y.

DEVICE FOR ILLUMINATING OIL GAGES.—By means of which practically all of the light from an incandescent lamp is projected through the gage. Patent 1549800. M. D. Prouty, R. Craig, C. Rawlins and H. Carlson, Galva, Iowa.

Machines and Mechanical Devices

TRAP.—A spring trap adapted for mice, rats, and the like, the device may be safely and easily set without soiling the hands. The inventor has been granted two patents of a similar nature. Patents 1541855 and 1541856. E. Sands, 563 King St., Charleston, S. C.

FLYTRAP.—Including a frame structure for removing and trapping the flies from cattle as the cattle pass therethrough. Patent 1541805. C. A. Fleming, Huntsville, Mo.

SAFETY BRAKE ENGINE.—In which mechanism is provided whereby the engineer can normally operate the valve controlling the operation of the brake. Patent 1541833. H. H. Logan, 1765 Winnemac Ave., Chicago, Ill.

LENO LOOM.—Which incorporates means whereby certain of the warp threads are twisted with other warp threads for locking the picks in position. Patent 1543045. J. S. Bachman, S. A. Moak and S. C. Lewis, c/o Anchor Duck Mills, Rome, Ga.

DOUGH CUTTING MACHINE.—Whereby a strip of dough may be cut into a plurality of uniform pieces to facilitate the handling. Patent 1543136. J. B. Ward, 1101 No. 5th St., Nashville, Tenn.

LEAF TURNER.—Which will turn the leaves singly in one direction, and all the leaves in the opposite direction at a single operation. Patent 1543599. F. R. Chester, 1416 Broadway, New York, N. Y.

SMOKEHOUSE.—Providing an article supporting cage and means for revolving the same by central rotary movement. Patent 1543596. J. Brand, c/o M. Brand & Sons, 1st Ave. and 49th St., New York, N. Y.

WAVE MOTOR.—Including a plurality of float operated elements associated with shafts to effect rotation in one direction. Patent 1542464. I. M. McNeil, 2481 Lowella Ave., Venice, Calif.

BALANCE-WHEEL SUPPORT.—For supporting the balance wheel of a watch, so that the rim will not become bent while it is being worked on. Patent 1543088. B. H. Ballard, 1046 Ventura Ave., Berkeley, Calif.

CORE-BARREL CONNECTION.—Providing means between the hollow shaft and bit for washing out mud without interfering with the sample core, in well drilling. Patent 1544167. A. J. Nightingale, Route 1, Box 72 C, Huntington Beach, Calif.

ORE JIG.—Particularly adapted for extracating the lower gravity materials and middling products as well as the very fine ores. Patent 1543987. E. M. Dougherty, 906½ Main St., Joplin, Mo.

ELEVATOR.—For use in supporting oil well casings, tubing and drill pipes, with locking means for holding against opening. Patent 1543966. C. F. Williams, Box 578, Tonkawa, Okla.

MEASURING FAUCET.—For dispensing liquids such as kerosene, gasoline, etc., in predetermined quantities. Patent 1544449. C. and C. Haarberg, R. F. D. No. 1, Box 57, Kent, Wash.

SHEAVE OR PULLEY.—Especially designed for use on the tops of poles, such as electric light poles, or the like. Patent 1544275. C. H. Sears, Kent, Wash.

WATER MOTOR.—Constructed in such manner that the wheel may be adjusted to the rise or fall of the river. Patent 1545774. E. A. Jenks, Alderpoint, Calif.

PUNCH PRESS.—Whereby the hand of the operator will be positively withdrawn before the ram begins to descend. Patent 1546298. T. W. McGrath, 50 Grove St., New Britain, Conn.

APPARATUS FOR THE DISTILLATION OF CARBONACEOUS MATERIALS.—In which carbon formed during distillation is continuously scraped from the heating surfaces to

prevent overheating. Patent 1546285. J. B. Kirk, 2 W. Buchanan St., Iola, Kan.

AWNING ROLLER.—Which will effectively guide the awning as it is raised or lowered. Patent 1546226. D. Froehlich, 870 DeKalb Ave., Brooklyn, N. Y.

GOLF PUTTING DEVICE.—For indoor use in practising putting strokes, the force applied to the ball being accurately registered. Patent 1546260. A. B. Scott, Fairmont, W. Va.

ROTARY PUMP.—Adapted for sustaining the column of water in the discharge pipe, so that the runner is not unnecessarily burdened. Patent 1545905. A. L. Kins, Lawrence, Kan.

BAILER.—For introducing water into the bottom of an oil or gas well so that the cuttings may be efficiently withdrawn. Patent 1545758. C. L. Green and W. W. Hines, 509 National Bank of Commerce Bldg., Tulsa, Okla.

AUTOMATIC CONTROL FOR MOTION-PICTURE PROJECTORS.—For setting one motion picture projector in operation the instant another has completed the last of a film mounted on its reel. Patent 1547144. N. Hoiness, 464 Fiftieth St., Brooklyn, N. Y.

CUTTING MACHINE.—For cutting resilient compressible substances, especially for slitting rubber sponges for the reception of soap cakes. Patent 1545332. N. Kase, Kase-Quinby Rubber Co., 935 Broadway, New York, N. Y.

DOUGH SPACER.—Wherein the dough may be readily received and discharged at timed intervals to a traveling belt. Patent 1545,400. O. W. Comstock, Valley Stream, N. Y.

SAWING MECHANISM.—Relating more particularly to mechanism for sawing granite, marble, and various kinds of stone. Patent 1545447. W. H. B. Perry, c/o Perry Granite Corp., Waterbury, Vt.

COMBINED BRAKING AND CLUTCHING MECHANISM.—Operated as a fluid control to prevent rotation of the usual transmission gear when the clutch is out and the gears being shifted. Patent 1544721. H. L. Bredlow and L. L. Smith, 722 So. 3rd Ave., Wausau, Wis.

BOILER FITTING OR CONNECTION.—Which eliminates the necessity of utilizing packing, yet affords a mechanical as well as a fluid connection. Patent 1544664. A. A. Lindley, 1728 W. Riverside, Spokane, Wash.

MATCH-MAKING MACHINE.—Pertaining particularly to the manufacture of match packets or matches in book form. Patent 1547948. T. A. Nevins, c/o Hercules Match Corp., 84 No. 6th St., Brooklyn, N. Y.

PISTON PACKING.—Which prevents an excess of oil finding its way into the combustion chamber of an engine or working space of a pump. Patent 1547917. D. E. Holverson, 120½ Main St., Aberdeen, So. Dak.

SAFETY DEVICE FOR CLOTHES WRINGERS.—Readily attached to any standard type of wringer for stopping operation of the rollers and protecting the operator's hands. Patent 1547992. C. W. and E. F. Young, 579 W. 161st St., New York, N. Y.

CASTING MACHINE FOR STEREOTYPE PLATES.—In which a cock is used for controlling the flow of metal, and by forcing oil into the bearing both on opening and closing the cock. Patent 1547988. C. Winkler, Berne, Switzerland.

COOLING AND VENTILATING SYSTEM.—For large enclosed spaces, by means of which fresh air will be introduced in such manner as to permeate all of the space. Patent 1547317. E. Glantzberg, 281 Lexington Ave., New York, N. Y.

PISTON.—By means of which leakage past the piston is minimized, and the piston and cylinder used for a long time without repair. Patent 1548005. J. E. D. Isakson, 449 51st St., Brooklyn, N. Y.

ADJUSTABLE GANG CUTTER.—Of the rotary type, having a plurality of knives for cutting parallel strips of material such as candy or dough. Patent 1546676. H. Ricci, 555 2nd Ave., San Francisco, Cal.

MOLD FOR CASTING STEREOTYPE PLATES.—In which the clamp holding one edge of the matrix is mechanically moved to strip the matrix off the plate. Patent 1547989. C. Winkler, Berne, Switzerland.

FLUID-PRESSURE JACK.—The lifting capacity and size of the machine, being determined by the weight and character of the object. Patent 1548559. R. W. Simpson, 711 Poplar St., Memphis, Tenn.

COUNTING APPARATUS.—Particularly adapted for the quick and accurate checking of the number of items in a column of figures. Patent 1548102. F. W. Sherman, c/o Barnett National Bank, Jacksonville, Fla.

DEHYDRATING APPARATUS.—Comprising a case, and an inner casing for supporting articles to be dehydrated, and means for utilizing a large percentage of heat. Patent 1547561. M. E. Bussler, 521 St. Philip St., New Orleans, La.

AUTOMATIC CUT-OFF.—Providing mechanism for gathering oil at a central point from many individual tanks, and shutting off the line at a predetermined time. Patent 1548,298. G. E. Woodard, Nowata, Okla.

ROCK CRUSHER.—Of the centrifugal type, designed for continuous operation, having interchangeable metal blocks against which the rocks are thrown. Patent 1547385. A. D. Hadsel, 500 Call Bldg., San Francisco, Calif.

SIGNAL ATTACHMENT FOR WOOL OR WORSTED CARDS.—Which will signal if a rope of wool or "overhead" breaks in transit from one machine to another. Patent 1549626. C. S. Tasker, J. A. Tabor and J. F. Small, c/o C. S. Tasker, Corinna, Me.

Medical Devices

PARALLELOMETER.—Which allows of the definite positional adjustment of pins, posts, attachments or other parts used by dentists. Patent 1546667. J. A. Lentz, 44 No. First St., Phoenix, Ariz.

LEG AND FOOT DEVELOPER.—Embodying elements, constituting artificial ligaments, which subject the hips, legs and feet to resistance in walking to activate the muscles and restore them to normal functions. Patent 1548711. J. J. Cooper, 56 W. 47th St., New York, N. Y.

Prime Movers and Their Accessories

INTERNAL-COMBUSTION ENGINE.—A device adapted to be connected with an engine for cutting out the ignition when the lubricating pump fails to work. Patent 1547207. H. E. Downing, Monta Vista, Colo.

GAS ECONOMIZER.—Whereby the air is washed, heated and vaporized, prior to being supplied to the carbureter, thus insuring complete combustion. Patent 1548301. C. Barchus, Natchez, Miss.

ROTARY GASOLINE ENGINE.—Which combines the merits of the reciprocating engine and the rotary engine in a single machine. Patent 1549015. J. H. McCarthy, 156 W. Grand Ave., Chicago, Ill.

TWO-CYCLE INTERNAL COMBUSTION ENGINE.—Suitable for use upon a motor car or motorcycle, capable of operation by either liquid or gaseous fuel. Patent 1550536. G. P. Godfrey, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

VALVE MECHANISM.—By means of which the noisy operation of overhead valves is eliminated and the oiling arrangement improved. Patent 1549636. W. H. Von Hacht, 722 33rd Ave., San Francisco, Calif.

INTERNAL-COMBUSTION ENGINE.—With means for scavengering the cylinder by the centrifugal motion of a helically injected stream of cool air. Patent 1550702. C. Knott, c/o Missouri Athletic Club, 4th and Washington Aves., St. Louis, Mo.

INTERNAL COMBUSTION ENGINE.—Having a special form of device for introducing a combination of liquids in the form of vapor into the combustible mixture. Patent 1550,967. H. A. Kelty, 122 Guest St., Newcastle, Pa.

INTERNAL-COMBUSTION ENGINE.—Of the two-cycle type in which all of the functions are performed without the use of valves. Patent 1550704. C. Knott, c/o Missouri Athletic Club, 4th and Washington Aves., St. Louis, Mo.

Railways and Their Accessories

OVERHEAD RAILWAY.—Acting to provide transportation facilities without using an appreciable amount of the street, and is comparatively inexpensive. Patent 1549625. H. H. Swift, Millbrook, N. Y.

TIE AND FASTENER.—Wherein a reinforced metallic tie with H-shaped fastener plates are utilized. Patent 1550584. J. G. Snyder, 620 W. 116th St., New York, N. Y.

RAIL TIE AND FASTENER.—The inventor has been granted three patents of a similar nature, relating to ties constructed of metal, and presenting ample surface to the roadbed for properly supporting rails of any kind, and firmly secure the rails to the tie. Patents 1550924, 1550925 and 1550926. J. G. Snyder, 620 W. 116th St., New York, N. Y.

Pertaining to Recreation

BOWLING GAME.—Comprising a board with radially arranged spaces, an indicator to be revolved, the score being determined by the space at which the arrow rests. Patent 1540288. E. C. Schallis, P. O. Box 31, Union City, N. J.

GAME.—To be played either indoors or outdoors, in which players move around bases and employ a bat and ball. Patent 1547222. J. J. Lynch, 127 Schermerhorn St., Brooklyn, N. Y.

FIGURE TOY.—To be manufactured in the form of a blank, having a plurality of fold lines to be assembled. Patent 1547967. W. Shilhan, 160 Bleecker St., New York, N. Y.

GAME APPARATUS.—The inventor has been granted two patents of a similar nature, relating to the games of chess and checkers, and comprising a game board, game pieces, and a folding container, occupying but small space when not in use. Patents 1549610 and 1549611. D. Reisz,10010 South Boulevard, Cleveland, Ohio.

CHILD'S VEHICLE.—In which a member suspended from the foot pedal effects the continuous forward propulsion. Patent 1549,517. W. O. Spoerry, 705 Fairmont Place, Bronx, N. Y.

Pertaining to Vehicles

LOCK.—Which will automatically hold the door of an automobile in closed position and eliminate rattle. Patent 1543755. P. Ebbesen, 906 Vista St., Hollywood, Calif.

FENDER.—Wherein a collapsible safety guard is provided, which may be nested or is capable of quick and easy distention. Patent 1544444. M. K. Gilewicz, 600 E. 139th St., New York, N. Y.

BRAKE LOCK.—For rigidly fixing the brake lever of a motor vehicle in position when the brakes have been applied. Patent 1545287. T. J. Stephenson, P. O. Box 642, Montrose, Calif.

DIRIGIBLE HEADLIGHT.—In which the headlights may be automatically controlled to follow the movements of the vehicle, or the beams varied as desired. Patent 1545179. A. C. Woodruff, c/o W. G. Howell, 1324 Milwaukee St., Portland, Oregon.

DIRECTION-INDICATING MECHANISM.—Controlled by the movements of the steering post of a vehicle. Patent 1546275. E. J. Wilson, Jr., 937 Reynolds St., Peekskill, N. Y.

LOCK.—For the tank of an automobile, closing the filling member and effectively excluding dust or other foreign matter. Patent 1544951. S. S. Sollee, c/o Sollee & Co., Savannah, Ga.

WINDSHIELD.—The outer surface of which may be cleaned from within the car, during a rain storm, without the operator getting wet. Patent 1546256. G. C. Savage, Glastonbury, Conn.

ATTACHMENT FOR CLUTCH PEDALS.—For supporting a push button, for operating the usual horn of an automobile, independent or in conjunction with the pedal movement. Patent 1545908. J. C. Long, 66 Mable St., Charleston, S. C.

TIRE CHAIN.—Having a simple and adjustable interlocking arrangement for securing the chain in a readily releasable position on a tire. Patent 1546430. R. S. Blitz, c/o C. R. Leonard, Atty., Butte, Mont.

RESILIENT WHEEL.—Constructed with spring cushioning action which enables a solid rubber type of tire to be used. Patent 1546513. E. H. Sipes, Tripp, S. D.

TRAILER ATTACHMENT FOR MOTOR TRUCKS. Whereby the trailer truck can rock transversely without causing strain of the connecting means, or the vehicle frame. Patent 1546743. W. C. Nabors, c/o Nabors Garage, Mansfield, La.

RUNNING BOARD FOR AUTOMOBILES.—Which affords ample escape for water or dirt, and prevents a person entering the car from marring the side of the body. Patent 1547095. E. Crawley, Uncasville, Conn.

STEERING-WHEEL HEATER.—Which will not interfere with the manipulation, nor detract from the appearance, of the steering wheel. Patent 1546413. S. Solomon, c/o Solomon Junk Co., 566 Poplar St., Fostoria, Ohio.

CLUTCH MECHANISM FOR TRANSMISSION.—With positive means for connecting the engine shaft with the propeller shaft without the necessity of springs or the like. Patent 1546672. A. F. Peacock, 302 Days Ave., Buchanan, Mich.

DUMPING BODY.—Including an automatically shifting tail gate whereby the dumping may be accomplished without the driver leaving his seat. Patent 1547525. R. L. Saxon and J. W. Dickinson, Box 202, Little Rock, Ark.

CONTROL SWITCH FOR HEADLIGHTS.—For dimming the lights, and may be operated by a foot of the driver. Patent 1547745. M. Goodrich, Box 109, Charlotte, Mich.

VEHICLE.—Adapted for travel through the water and capable of locomotion on the land. Patent 1547265. F. T. Ramsey, The Austin Nursery, Austin, Texas.

CHILD'S VEHICLE.—Which closely resembles a miniature airplane both in appearance and its movements when propelled on the ground. Patent 1547372. A. L. Erickson, 6215 22nd St., N.E., Seattle, Wash.

HEADLIGHT.—Projecting the light rays in a downward and forward direction, preventing glare on the eyes of persons approaching. Patent 1547757. W. B. Johnson, 112 Warren St., Lexington, Ky.

BUMPER.—Which when receiving an impact will not only protect the car but will be retracted and prevent injury to the bumper. Patent 1548087. N. Heller, c/o Y. M. C. A., Golden Gate Ave., San Francisco, Calif.

RADIATOR CAP.—Which has a valve for the escape of excess steam and an audible signal when the pressure passes a predetermined point. Patent 1548244. L. Baskin and G. Wolosh, c/o Sterling Auto Device Co., 206 S. Jefferson St., Chicago, Ill.

EXHAUST DEFLECTOR FOR MUFFLERS.—Causing the gas to be deflected to a point where it will do no harm to the tires or other parts of the car. Patent 1547413. G. L. Davis, 17 Spear St., San Francisco, Calif.

VEHICLE.—More particularly in the nature of a child's vehicle, of the conster wagon type. Patent 1548266. P. B. Hall, Carrington, N. D.

STEERING POST FOR AUTOMOBILES.—So positioned that it allows the driver to manipulate the wheel while his elbows rest against his body. Patent 1548411. G. R. Derr, Santa Margarita, Calif.

TRAILER FOR VEHICLES.—Which may be connected with the frame of a draft vehicle in such manner that shocks and jars will be dissipated. Patent 1548987. C. S. Drane, c/o A. B. C. Trailer Truck Co., Memphis, Tenn.

LUGGAGE CARRIER.—Easily set up to provide a reliable carrier of ample capacity on the running board of an automobile. Patent 1549135. W. Kadletz, Salmon, Idaho.

AIR BRAKE FOR MOTOR VEHICLES AND THE LIKE.—In which the force employed may be carefully regulated, so as to apply the brakes slowly or quickly. Patent 1548991. S. Giovannini, 658 N. La Salle St., Chicago, Ill.

CONVERTIBLE VEHICLE BODY.—Designed to constitute a cab for the accommodation of passengers or baggage, or used as a portable boat. Patent 1550498. G. A. Brown, 179 Observer St., Rockville Center, L. I., N. Y.

Designs

DESIGNS FOR DRESSES.—The inventor has been granted two patents for dress designs. Patents 67880 and 67881. Taube Davis, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A SOUND AMPLIFIER.—Patent 67899. B. Mazanek, 400 E. 75th St., New York, N. Y.

DESIGN FOR A COMBINED VANITY COMPACT AND CIGARETTE CASE.—Patent 67897. S. Q. Lupo, c/o Columbian Manicure Mfg. Co., 3636 Park Ave., New York, N. Y.

DESIGN FOR A CHEST.—Patent 67930. F. H. Lynd, 158 Morris St., Morristown, N. J.

DESIGN FOR A COMBINED SLIP AND SHAPED BRASSIERE.—Patent 67947. Taube Davis, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A SHOE.—Patent 67996. Taube Davis, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A COMBINED BRACKET AND BRACE.—Patent 67989. J. H. Balmer, 259 Plane St., Newark, N. J.

DESIGN FOR A BADGE.—Patent 67995. J. A. Bodnar, c/o Standard X-Ray Scales Corp., 178 E. 85th St., New York, N. Y.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

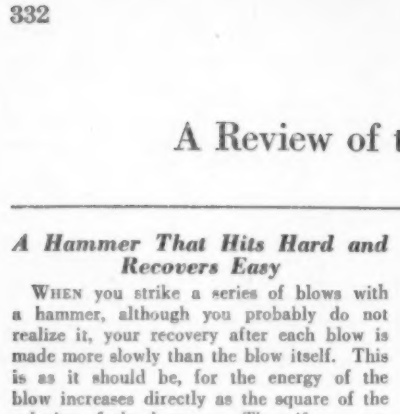
A Hammer That Hits Hard and Recovers Easy

WHEN you strike a series of blows with a hammer, although you probably do not realize it, your recovery after each blow is made more slowly than the blow itself. This is as it should be, for the energy of the blow increases directly as the square of the velocity of the hammer. Thus if you can double the speed with which you swing the hammer or axe, or anything with which you strike, you will thereby give the blow four times the energy it had.

This principle has now been applied to the electric hammer, just as it has been applied to the levers which carry the letters of a typewriter, speeding them up as they approach the page so that without speeding up the blow of the finger, the letter is impressed more strongly on the page. In the case of the electric hammer you have a plunger and you want to find a way to transmit a reciprocating motion to it by means of an electric motor in such a way that, as the plunger, bearing a tool, is shot outward, it will speed up and strike a correspondingly more energetic blow.

This problem has been solved by Mr. H. P. Brumell, who makes use of the devices shown in the accompanying cuts. The electric motor has a crank, whose crank pin is shown at P. It bears a roller, R. The crank revolves in a circle at uniform speed, as indicated by the circle, S, Figure 1. The plunger in which this crank pin and roller works has a curved slot, and it is the peculiar shape of this slot which brings about the desired velocities of the plunger at various parts of its strokes. How this works should be almost self-evident from a study of the four positions indicated in the cuts. The tool is attached to the lower end (in the cuts) of the plunger, which moves back and forth between the confining roller guides shown at its sides.

Figure 1 shows the plunger in what we will call its neutral position, that is, when resting against the shoulder C at the completion of its stroke. The roller R is approximately on the line FF. It now moves



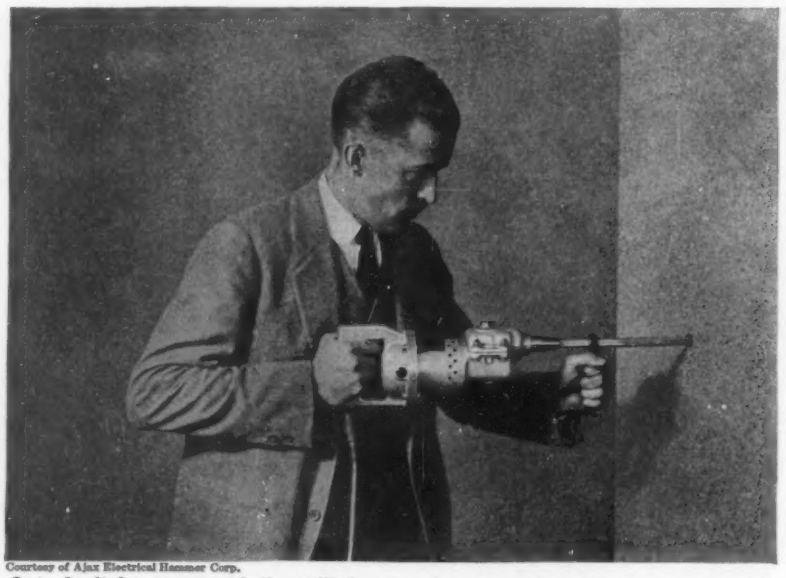
Left: **In neutral position.** ***Right:*** **The plunger goes up, and—**(Continued in right-hand column)

along its path until it exhausts its clearance in the slot and comes in contact with the upper side A, as shown by the dotted circle. In continuing along its path from this point the crank roller decreases its distance from the guide roller R1. This causes a squeezing action, and as the angle formed by the tangent at the point of contact of the roller on A, and the surface bearing on R1, is sufficiently obtuse, the plunger G is forced upward. Its upward speed increases until the position shown by Figure 2 is reached.

From this point it is retarded by the roller R until brought to rest in Figure 3. The crank roller, bearing now on the lower side B of the slot, moves toward the guide roller R2, again causing a squeezing action.

This time, however, the angle formed by the tangent at the point of contact of the roller on B, and the side bearing on the roller R2, becomes continually more acute. This causes an increase in the downward velocity of the plunger, from O in Figure 3 to a maximum of more than twice the speed of the crank roller in Figure 4.

At this point, as the plunger has reached maximum velocity, the tendency of the crank roller would be to retard its speed, but owing to the clearance of the roller in the slot, the plunger is freed and allowed



Courtesy of Ajax Electrical Hammer Corp.

It is the lighter man with "speed" that you fear more than the slower man with avoirdupois. This hammer's virtue is speed

to deliver its energy to the head of the tool D, finally coming to rest and completing the cycle.

By releasing the plunger at the time of maximum velocity, all backlash on the transmission is eliminated, and an unhindered blow is delivered. As the housing of the tool is made of aluminum its weight is low, making it available for all sorts of jobs where standard weight apparatus would be rather bulky.

* * *

"Hooverising" the Governmental Bureaus

THE United States Bureau of Mines, which has until recently been one of the bureaus of the Department of the Interior, was transferred last June to the Department of Commerce, under Secretary Hoover. Thus, within a short space of time two departmental bureaus, the Patent Office and the Bureau of Mines, have been placed in care of the efficient Department of Commerce.

Secretary Hoover has announced that steps will be taken to increase the efficiency of the Bureau of Mines, which has already proved highly valuable to the nation. The Secretary is himself a mining engineer and had been actively engaged in consulting mining engineering work right up to the time, in 1914, when the sudden beginning of the war left Belgium hungry and in need of a practical man who could do things quickly and cut red tape.

It is anticipated that the Secretary, with the same genius for practical efficiency which made him invaluable to the world during the Great War, will find a way to make the bureaus which have been transferred to his care, more valuable, even, than they have been to the American people.

The Bureau of Mines has done an immense amount of work, both in fundamental research and in lines more immediately applicable to the industries, including in many cases, other than mine industries.

The changes in control announced will obviate a considerable amount of duplication of effort, various bureaus working under separate governmental departments, previously having had overlapping functions.

The readers of the Scientific American find the Bureau of Mines extremely valuable. Large numbers of inquiries are either referred to this bureau because these inquiries concern work which the Bureau has been doing and is therefore closely in touch with, or they are answered by our own staff from information originally obtained by research in the laboratories of the Bureau and kept on file in our offices.

* * *

How Much Extra Energy Do Balloon Tires Absorb?

ALTHOUGH the impression that balloon tires cause a considerable loss of power in the automobile seems to have become quite widespread, the Bureau of Standards of the Department of the Interior has demonstrated as the result of an investigation, that the rolling resistance of balloon tires is only slightly higher than that of high-pressure cord tires, and is substantially lower than the rolling resistance of high-pressure fabric tires.

As between balloon tires and high pressure cord tires, therefore, on smooth roads, there is a slight difference in gasoline consumption in favor of the cord tires. This difference may decrease, or disappear altogether, on rough roads. This is due to the tendency of balloon tires to reduce the losses of energy brought about by vertical movement of the car body.

These results are published in Technologic Paper No. 283, "The Effects of Tire Resistance on Fuel Consumption." This paper is summarized in the May 21, 1925, issue of *Automotive Industries* (New York).

While a blanket statement cannot be made that a change from high pressure to balloon tires, will result in an increase in rolling resistance, as the difference between the two types is comparatively small and individual balloon tires may show a higher or a lower rolling resistance than individual high pressure tires, as a class, balloon tires have a greater rolling resistance than high pressure cord, the difference depending upon the inflation pressure considered.

In the absence of a recognized standard for inflation pressures, comparisons are made on a basis of 30 pounds per square inch for balloon tires, 45 pounds for three and one-half-inch cord, 50 pounds for four-inch, and 60 pounds for five-inch cords. On this basis the average rolling resistance for high-pressure cord tires is 11.8 pounds per thousand pounds axle load; for balloon tires, 13.5 pounds; and for fabric tires (except the three and one-half-inch size) 17.1 pounds.

Thus it is seen that the gain in cushioning which is known to result from the use of balloon tires is obtained at an increase of 1.7 pound in rolling resistance. If, on the other hand, the road is rough, the balloon tire favors a reduction in the loss due to energy absorbed by springs and snubbers, caused by a vertical movement of the car.

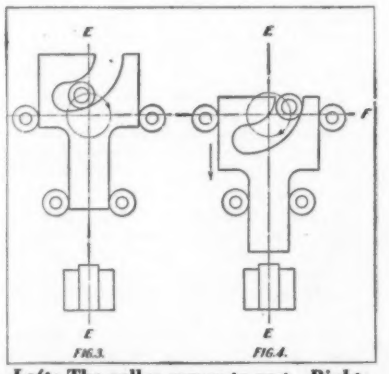
* * *

Why Some Roads Become Corrugated

EVERYONE who motors is familiar with roads that resemble a washboard. Often they are worse than plain dirt roads, for the constant vibration caused by running over an endless series of evenly spaced hummocks or "waves" is nerve racking. Most people blame the contractor who built the road, but research conducted at the United States Bureau of Public Roads has demonstrated that roads get into this condition as a result of the natural vibration period of automobile tires. The technical considerations surrounding this discovery are decidedly interesting.

The corrugations are so evenly spaced that the belief that they were related to some definite cause and have not merely "happened to be there" is irresistible. According to Lieutenant Robert J. Walker of the United States Navy, in the May 7, 1925, issue of *Engineering News-Record* (New York), they are caused by some force having a definite or rhythmic time period.

In order to test this suspicion, the gravel road between Washington, D. C., and Annapolis was taken as a typical example and numerous trips were taken over it under all



Left: **The roller comes to rest.** ***Right:*** **As the plunger is shot out, the speed is doubled**

kinds of weather conditions. On such a road there is a speed at which the vibration caused by the hummocks is most pronounced. This speed is called the critical speed and it varies on different roads between twenty and thirty miles per hour, all other speeds causing very little vibration.

The natural assumption is that the corrugations must be caused by some part of the car which has a natural vibration period. Moreover, if the explanation is to have any actual meaning or significance, this period must be common to the majority of cars. In other words, whatever explanation is given, must explain. We will now go a-sleuthing for the part of the car which has the predicated vibration period.

(Continued on page 334)

A car traveling over the road at common motoring speed of twenty-five miles per hour with the crests of the corrugations thirty-one inches apart (the mean distance between crests as observed by the United States Bureau of Public Roads) would vibrate up and down once every .07 of a second. The springs of the average car, however, have a natural vibration period of .09 of a second. Thus, the springs are ruled out of the consideration and we try some other part.

The period for engine firing impulses for six and four-cylinder cars traveling at the same speed as before are about .006 and .009 seconds, respectively. Too short; they too are ruled out.

Now let us study the tires of a car, treating them as loaded springs and finding their natural periods of vibration. By a series of mathematical calculations we get for a Chandler car, for example, with two passengers, 0.0846 second; and for a Ford car similarly loaded, 0.00866 second. If we assume twenty-five miles per hour for the heavier car we get a distance of thirty-seven inches between crests; and for the light car, 37.9 inches.

These figures are still about twelve percent too high, writes the Lieutenant, to agree with the average corrugation length found from the road observations made by the United States Bureau of Public Roads. This discrepancy is explained by the statement that the calculations were made on the assumption that the tires do not bulge when they are deflected. If, however, we consider this bulging effect, the supporting areas will increase more rapidly with given deflections; therefore, the deflections for the same sustaining loads will be less and the natural periods of vibration less, bringing the distances between crests exactly into coincidence with those observed.

There is no doubt, therefore, that these road corrugations are formed entirely by the pounding action of the tires themselves. They never occur on steep hills and this shows that they are not due, as sometimes said, to the kick-back of surface material arising from the spin of the wheels; for if this were actually the case we should find corrugations on hills where the tractive effort, and therefore the kick-back, is greater. The fact is that car speed being reduced on hills, the vibration periods change, and since few cars agree in speed on hills, no corrugations form there.

A balloon tire, however, has a very different natural period of vibration from a cord or fabric tire, a 31 by 4.4 inch balloon tire having a period of 0.114 second. Allowing for the twelve percent due to tire bulge, we alter this to 0.102 second. For a speed of twenty-five miles per hour, therefore, we find that such a balloon tire should tend to cause corrugations every 44.8 inches in the road. This is several inches longer than the case with the old style tires for which calculations were described above. Here, in fact, is the remedy for road corrugations. Since the balloon tire will tend to put different corrugations in the roads than the other tires, and since there will soon come a time when about half of our cars are equipped with balloon tires, the corrugation trouble should thus be automatically ironed out, for the vibrations of the balloon tires will cause the present crests of corrugations to be pounded down. When, still later on, the balloon tire becomes universal we shall again find corrugations, longer this time but just as deep.

But there will still be a solution. Lieutenant Walker proposes to checkmate this trouble by requiring the front wheels of our cars to be equipped with tires having an entirely different natural period of vibration from the rear wheels. For example, he says, if the front wheels of a Ford were equipped with standard 30 by 3½ inch tires, and the rear wheels equipped with 31 by 4.4 inch balloon tires, the rear wheels would pound down the crests tending to be formed by the front wheels.

* * *

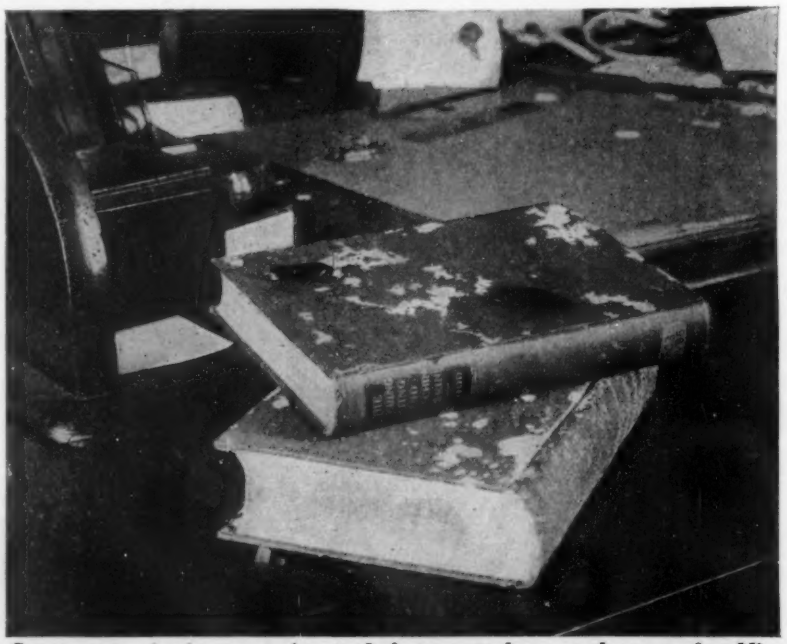
The Cockroach Is a Book Worm

THE lowly roach has studious tendencies; at least he haunts the bookshelves of libraries, says Miss Nell Ray Clarke of Washington, D. C. This insect has come into the limelight as the result of some of the work which is being done by students of leather problems in the United States Department of Agriculture who are always searching for means of improving book-binding materials and of increasing the life of books.

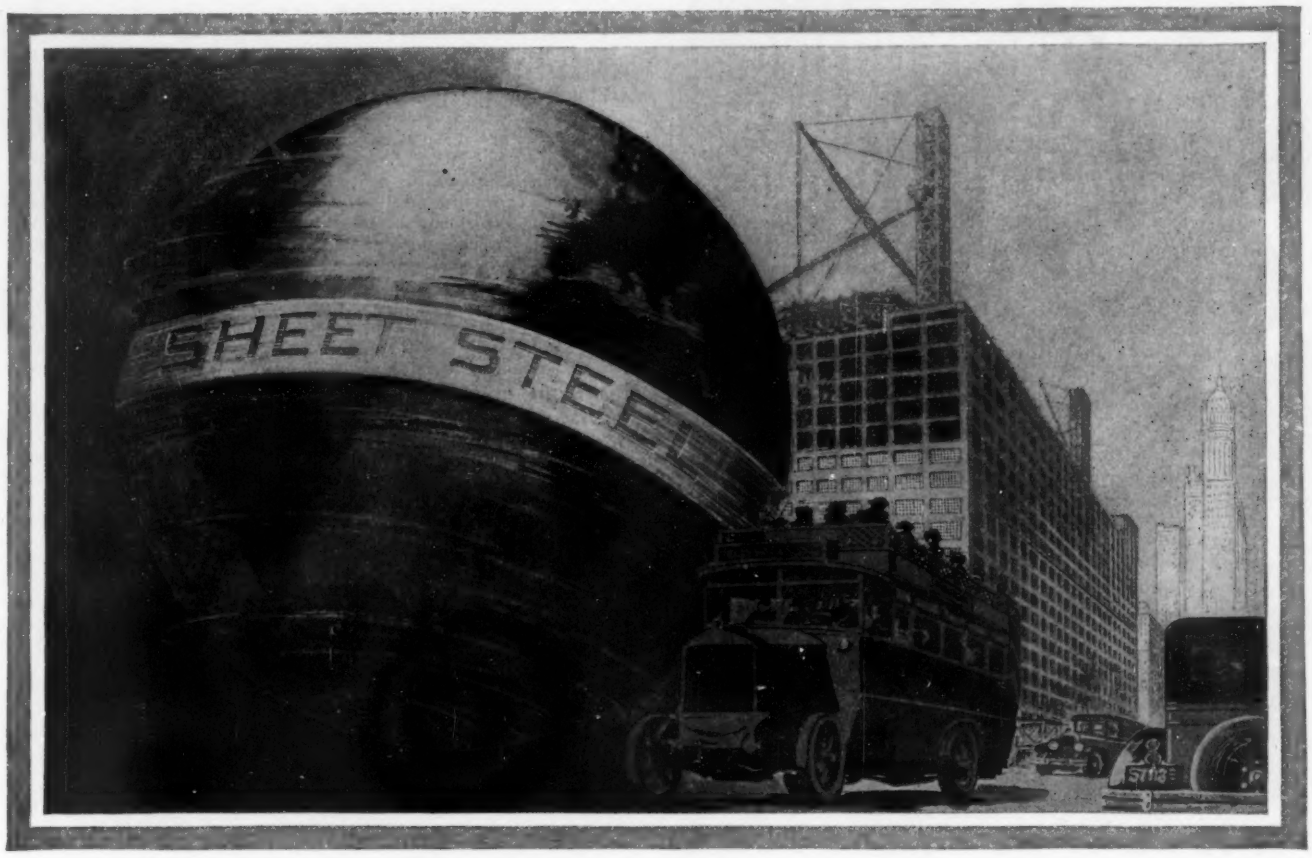
Many books which are never allowed to leave the sacred precincts of public libraries have been found to be spotted as if they had been left out in the rain. In seeking the cause of this peculiar damage, circumstantial evidence pointed to the fleet-footed devotee of the dusty stacks. It was found that the roach samples the cover of a book with saliva to see if he likes the filling materials which the manufacturer used in putting on the cover. If he does like it, he next works the starch, dextrin, flour and casein in the binding up into a mush and then consumes enough of it to make a comfortable meal.

The problem of what to do in order to stop the work of this voracious insect has not yet been solved, but the United States Bureau of Entomology is working on it. It is not possible to use, in making the binding, any substance which is poisonous to human beings, for someone's infant might

(Continued on page 336)



Government scientists are trying to find a way to keep roaches out of public libraries, where they injure the books



The Commercial World Is Moving Fast — And Carrying Many New Demands With It

IN less than one generation the automobile has all but driven horse-drawn vehicles from our highways—reinforced concrete buildings have passed from the stage of experiment to complete public acceptance as a standardized method of construction—and now the motor-bus bids fair to soon outrival the railways in passenger transport.

In all these developments Sheet Steel has played an important part. For construction of motor cars and buses it is an essential. In reinforced concrete construction it is no less so in the use of metal lath and expanded metal reinforcement as well as its use for construction "forms".

Every business man must realize the tremendous business changes brought about by these amazingly rapid developments, but how many of us appreciate the equally important tendencies which are developing with equal speed?

Steel furniture for residence, office, hotel and hospital use is growing in popular favor and demand at a rapid rate. How long will it be before it is the accepted standard?

The heated laundry dryer for domestic use in cabinet form awaits only the push of popular education and skillful merchandising to find as general acceptance and sale as the automobile or the washing machine.

Steel roofing in new and beautiful forms is rapidly coming into vogue, bringing with it an enormous new market.

The demand for garages and for "Summer cottages" in the woods and mountains and by the lake and sea presents a tremendous new field for construction in which standardized and organized large scale operations can best serve the public and for which Sheet Steel is an ideal construction material. You will be interested in our booklet, "The Service of Sheet Steel To The Public." Ask for a copy.

SHEET STEEL
TRADE EXTENSION COMMITTEE
OLIVER BUILDING
PITTSBURGH PENNSYLVANIA

chew up a binding any day for a pastime. If, on the other hand, some substance which is poisonous to roaches were to be used, the damage to the book will have been done before the funeral dirge of the roach can be sung. The logical thing to do, then, would be to use some insect repellant having an odor. But even if the odor were a pleasant one, the odor emanating even from a small library of 3,000 books would asphyxiate a librarian. In time, moreover, it would volatilize entirely and would thus become ineffective.

Aside from fumigation, the most effective simple means of ridding the library of the pests is to blow sodium fluoride over the shelves and the books, or to distribute phosphorous paste on bits of cardboard among the stacks. But these of course, should be kept out of the way of children for they are poisonous.

* * *

Masurium and Rhenium—Two Missing Elements—Found

WHAT is known as Mendeleieff's Periodic System strikingly proves the existence of an intimate connection between the respective atomic weights and chemical properties of the elements. In this list, the elements are arranged according to increasing atomic weights, so that elements of similar properties are placed above one another in vertical columns.

When this system was first established, Mendeleieff was able to predict a number of properties of the missing elements, it being rightly assumed that the behavior of neighboring elements both in horizontal and vertical rows would not show any abrupt change. Of the 92 elements making up the fundamental table, only about 80 were then known.

Modern physical theories have shown the Periodic System to be of paramount importance for the very structure of matter. The original criterion—the atomic weight of an element—has long been abandoned and replaced by its order of numbers (from 1 to 92). This number, at the same time, represents the number of free positive charges in its atomic nucleus, as well as the number of electrons revolving around them in accurately fixed paths.

After the recent discovery—thanks to Prof. Niels Bohr's views on the structure of atoms—of element 72 which was eventually named hafnium, there remained only five gaps in the long sequence of elements. Two of these gaps have now been filled, respectively by Dr. Walter Noddack, of the Physico-Technical Testing office, and by a woman physicist, Dr. Ida Tacke, in co-operation with Dr. Otto Berge, of the Werner Siemens Laboratory.

The new elements belong to what is understood as the manganese series which has exhibited two gaps. The presence of these gaps had already been ascertained both by chemical methods and by X-ray spectroscopy. Several minerals, for example, columbite and gadolinite, were found to contain the two elements in extremely small amounts. In fact, their share in the composition of the earth's crust or lithosphere is about 1/10,000,000,000th of one percent. New methods of chemical concentration had therefore to be devised. This could not be done without a thorough investigation of the analytical behavior of the hypothetical elements. On the strength of this, Dr. Noddack succeeded in concentrating them 1,000-fold. Element Number 43 was eventually named *masurium* (or "Ma" in abridged form), and element Number 75 was named *rhenium* (or "Re" in abridged form).

The Danish daily press has just announced another forward step in the investigation of new elements. Mr. Berglund, Prof. Bohr's assistant, has succeeded in obtaining hafnium in a state of metallic purity. The mineral alvite, which contains about six percent of the newly discovered element, was used as a starting point and was submitted to oxidation, thus producing hafnium and zirconium salts, respectively. A long row of chemical processes had to be worked out in order to be able to separate these two salts, thus causing them to crystallize in a pure condition and ultimately to yield pure hafnium.

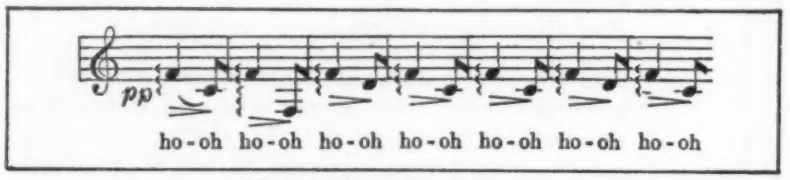
The new element has been obtained in the form of a greyish-black powder, closely resembling graphite. The melting temperature of the metal is so high that it has as yet been impossible to obtain it in a compact state, and the total amount so far produced is only two grammes.

It is thought that hafnium may assume some importance in the incandescent lamp industry and for the manufacture of vacuum tubes for wireless apparatus. New and cheaper methods of production will have to be devised before such an application is made possible.

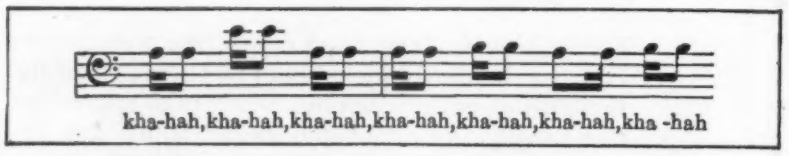
* * *

Are the Apes Learning Speech?

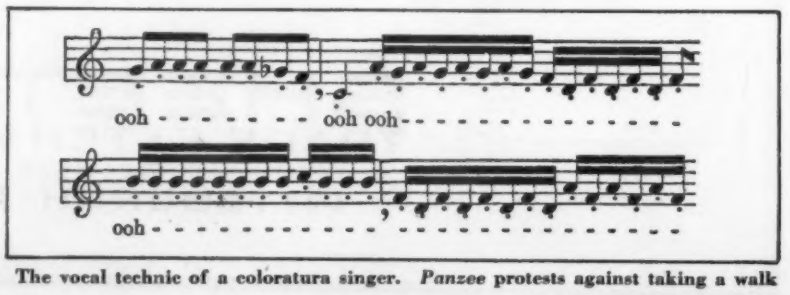
BEFORE one can answer this question there must be a clear understanding as to what is meant by speech. If speech means communication by means of definite, dictionary words, then the animals do not speak. When, however, we come to ask what a



***Banzee's* alarm at a motor car**



***Chim* has a fine sense of humor, laughing spontaneously**

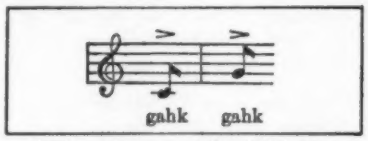


The vocal technic of a coloratura singer. *Panzee* protests against taking a walk

word is, we discover that it is only a sequence of sounds which is recognized by us all as signifying some definite concept. In this sense, then, the animals must be considered to use speech, for most of them do express concepts, elementary but quite definite, by means of sounds.

Thus we find that there is no very sharp line of demarcation between the elementary sounds that convey meanings between crows or horses and the complicated series of sounds used by man to convey more complicated concepts. The one grades by degrees into the other. Man is believed to have developed speech in his primitive days, hundreds of thousands of years ago, his few sounds evolving, as time went on, into a more complicated repertoire of thought-sound symbols.

This evolution is still going on among human beings, both civilized and uncivilized. There must have been a time, however, when man's ape ancestors had no better powers of audible communication than the monkeys and anthropoid apes of our time have. Probably his powers of speech were once on an even plane with those of the living anthropoids, although it would be unscientific to assume that man's ancestors went through the exact speech evolution which we now observe in the chimpanzees, or employed the same sound for the same things. It must be pointed



"When do we eat?" *Gahk* was always the food word

out, in addition, that we know, definitely, nothing about the development of speech among our more ancient ancestors, except by deductive reasoning. We have, however, found that some early races of men could not have spoken even as freely as the most primitive of living men, for we find that in some fossil jawbones the space for the tongue is too cramped for full play of that versatile organ.

Robert M. Yerkes and Blanche W. Learned have made a large number of valuable observations on the vocal expressions of the chimpanzee and have just published an account of these observations in a book entitled *"Chimpanzee Intelligence"* (The Williams and Wilkins Company, Baltimore, Maryland). The authors have made no effort to interpret the significance of the vocal expressions of the chimpanzees, the present work being preliminary to other interpretive books to follow later. What they have done is to take down in common musical notation the multitude of sounds made by two young chimpanzees, by name, *Chim* and *Panzee*.

Out of hundreds of records it appears that these primates are developing extremely elementary speech. At least they have certain words that they use on certain definite occasions. The food word is *"Gak"* or some cognate form. *"Kah-ha-ha"* is laughter. *"Ho-oh"* is alarm, and so on; though the vocabulary is extremely limited.

This book is related in its subject matter to *"The Mentality of the Apes,"* reviewed in the June issue of the Scientific American (page 412). In fact, the two authors of the present work have collaborated with Prof. Köhler, author of the earlier book. In a later book, Dr. Yerkes expects to tell of systematic efforts to teach a chimpanzee to speak. "The chimpanzee," he says, "possesses a vocal mechanism comparable to that of man, and, also a type and degree of intelligence which would enable it to utilize sounds effectively for purposes of speech."

* * *

Bloody Bread—the Mystery of the Scarlet Fungus

THERE is a very interesting history connected with one of the common laboratory organisms used by bacteriologists. In olden

times the bacterium, *Erythrobacillus prodigiosus*, although perfectly harmless, caused more deaths than many a deadly disease germ. Because of its rich, red color, the superstitious layman in medieval days often mistook it for blood. And because of the way they interpreted the appearance of "blood" on their food or on the church walls, many an innocent man suffered, and many lost their lives.

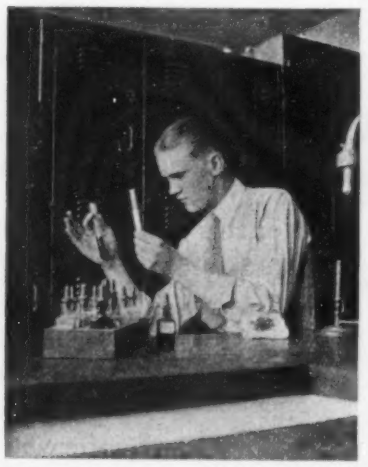
The first time we hear about this bacterium is in an account written in 332 B. C. when Alexander the Great was besieging Tyre. At that time, some of the Macedonians who were led by Alexander saw what they thought were drops of blood trickling from the bread when they broke it.

The red material coming from the inside of the bread was not blood, but a microscopic organism. When this organism grows, great numbers of the bacteria are grouped together, and for that reason they can easily be seen without a microscope. Because of their scarlet color, they were easily mistaken for blood by the superstitious Macedonians.

Bacteriologists can grow *erythrobacillus* on laboratory media without any trouble. It thrives quite well on bread, boiled potatoes, or any carbohydrate food. In fact it will live almost anywhere in the presence of moisture, warmth, and light, except in direct sunlight. Occasionally it occurs in milk on the farm or in the dairy, causing a bloody appearance.

Old accounts refer many times during medieval times to bloody bread. The churches, which were not too sanitary and clean in those days, furnished favorable conditions for the growth of bacteria. In 1169, at Alsen, Denmark, a certain priest's assistant saw blood on the Host when he elevated it. In his fright he showed the evil omen to the chief priest, who declared that some dire misfortune threatened the church, and that the blood of Christians would be shed.

It happened, by some chance or other, that what the old priest predicted was right, for two weeks later the army of the Selini "occupied all places, overthrew churches, drove all the people into slavery, and pursued anyone resisting with fire and sword."



The red bacterium that frightened the superstitious folk of the Middle Ages is now the plaything of the college student. Note "bloody" bread near student's elbow

In 1296, a Jew near Frankfurt bought a wafer from a boy, and this also became red when he stabbed it. When the people heard of this fact, a mob gathered and started a raid. Before the thing was over, 10,000 Jews were slaughtered, for the attack included several towns.

Thus *Erythrobacillus prodigiosus* made its appearance quite often in those times, and many an innocent man lost his life because of it. But in 1819, the first scientific investigations of this mysterious portend began.

At that time a very severe outbreak of the scarlet fungus occurred in the province of Padua. The red growth was first found in

the home of a peasant, Antonio Pittarello. There were blood-like spots on the *polenta* (corn porridge). Even though that was thrown away, spots came on the fresh *polenta* the next day, and on other food. The news of this phenomenon spread quickly, almost as quickly as news does today, and people of all ages flocked in to see the evil omen, as they considered it. These visitors frightened the good peasants more and more with their discussions of the meaning of this thing. Some thought it was the punishment of God because the people had held their grain for a higher price in 1817, and had made the *polenta* from that grain. Their fears and amazement became more pronounced when they saw that the prayers of the priest, fasts, and the Sacrament were of no avail.

Later, red spots occurred on food in the houses of other peasants throughout the province. Since the outbreak was so general, a commission was appointed, consisting of the higher officials and professors of Padua, to investigate the matter.

Meanwhile, two men threw much light on the whole thing, each in a different way. Bartolomeo Bizio, one of them, recognized this mysterious substance as a microscopic fungus. He was able to cultivate it, and found that it needed moisture and warmth to grow. He also found that the spores, its method of reproduction, could be dried for three years and would still germinate. That explains its seemingly sudden and untimely occurrence in so many cases.

The other investigator, Dr. Sette, grew the organism in the house of a priest, and thus proved that it could occur in houses other than those of offenders.

The Heavens in November

By Professor Henry Norris Russell, Ph.D.

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

The Heavens

THE winter constellations are now splendid in the east. Taurus and Auriga are high up. Orion and Gemini below and Canis Major and Canis Minor close to the horizon. Perseus, Andromeda and Aries are grouped about the zenith, while Eridanus and Cetus occupy the very dull region in the south. Pegasus is high in the west, and Aquarius and Piscis Austrinus low in the southwest. Cygnus and Lyra are in the northwest. Cassiopeia high in the north, Draco and Ursa Minor below the Pole and Ursa Major ascending in the northeast.

The Planets

Mercury is an evening star all this month —close to the sun at its beginning, but far enough out at elongation on the 22d to be seen, low in the southwest, half an hour after sunset. Venus is likewise an evening star, and at elongation (on the 28th) but being 47 degrees from the sun, as against 22 degrees for Mercury, she is conspicuous in spite of her great southern declination of 26 degrees, and remains in sight until about 7:30 P.M.

Mars is a morning star, rising about 5:00 A.M., but is not conspicuous. Jupiter is an evening star, setting about 8:15 P.M. in the middle of the month. On the 26th he is in conjunction with Venus, being two degrees 39 seconds north of that planet, and the two planets will be very conspicuous in the evening sky.

Saturn is in conjunction with the sun on the 10th and is practically unobservable. Uranus crosses the meridian about 8:00 P.M. and is observable in the evening; Neptune a little after 6:00 A.M. so that he can be seen in the morning (with a suitable telescope).

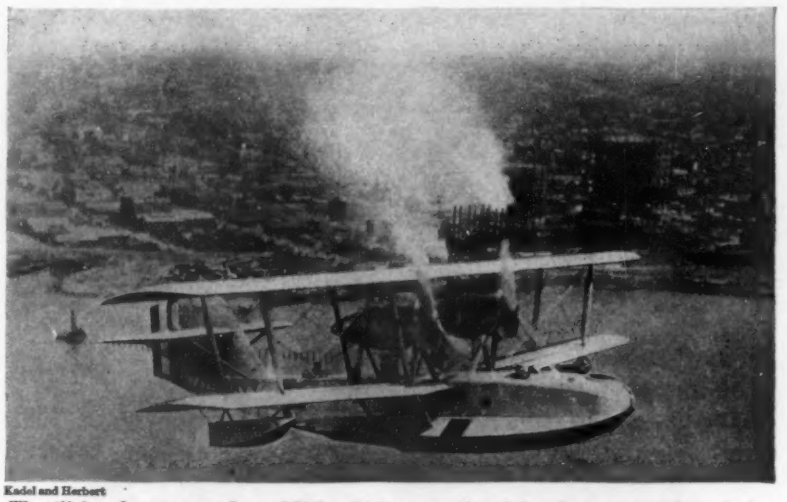
The moon is in her last quarter at 10:00 A.M. on the 8th, new at 2:00 A.M. on the 16th, in her first quarter at 9:00 P.M. on the 22d, and full at 3:00 A.M. on the 30th. She is nearest the earth on the 19th, and farthest away on the 7th. During the month she passes by Neptune, on the 9th, Mars on the 14th, Saturn on the 15th, Mercury on the 17th, Venus on the 19th, Jupiter on the 20th and Uranus on the 24th. The conjunction with Jupiter is close; indeed, an occultation is visible in the North Pacific Ocean and on parts of the western coast of America.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics



Kadel and Herbert

The ill-fated navy seaplane *PN-9*, which was piloted by the commander of the expedition, Commander John Rodgers, of the transpacific flight from San Francisco to Hawaii

Lessons of the Pacific Flight

IN planning the non-stop flight from San Francisco to Honolulu, the Navy had in view, primarily, a thorough service test of its very latest models of long distance patrol seaplanes to be used in conjunction with the fleet. Two flying boats of the *PN-9* type, and one of the *PB-1* type were to participate.

The trim *PN-9* is shown in the first of our photographs; a twin-engine flying boat, it carried its two Packard engines of 500 horsepower out on the wings. Its tail and hull were of duralumin sheet, giving lightness and strength and eliminating the water soakage ever present in wooden hulls—and water soakage means serious increase in weight. The spread of the upper wing is 73 feet, that of the lower 67 feet. Its wing area of 1,217 square feet supports a gross weight of 18,125 pounds which includes a crew of four, and fuel sufficient for a non-stop flight of 2,200 miles at a speed of 80 miles an hour. The *PN-9* is a direct development of the *F-5-L* which had rendered such consistent service to the Navy during and after the war.

The *PB-1* built for the Navy by the Boeing Aircraft Company of Seattle, is of even greater dimensions, with a spread of over 87 feet, a gross weight of 24,000 pounds when fully loaded. The *PB-1* carries a crew of five and fuel for a flight of 2,500 miles. Its two engines are mounted in tandem, as shown in our photograph, and each develops 725 horsepower. The advantage of mounting the engines in tandem on the center line of the seaplane is obvious; if one motor quits, no eccentric force is introduced, and the seaplane is likely to be able to continue its flight indefinitely on one motor.

It is interesting to compare these modern seaplanes with the once famous *NC-4*, the first plane to cross the Atlantic in May, 1919. Equipped with four Liberty motors of 400 horsepower each, the *NC-4* weighed 28,000 pounds and had a wing spread of 126 feet. Yet while the *NC-4* was much bigger, heavier and was equipped with more horsepower than the *PN-9* or the *PB-1*, it flew slower and had a range of only 1,600 miles (the longest hop she made across the Atlantic was only 1,380 miles).

In addition to progress in construction, much has been learned in navigation and flying generally since war time. The Navy made its preparations with extraordinary thoroughness, covering the sea with destroyers, and painting the wings of the seaplanes yellow, a color which experience has shown to be most vividly in contrast with the usual green or blue of the sea.

The distance from San Francisco to Honolulu is 2,030 miles. The *PN-9* could cover

Wide World

The navy seaplane *PB-1*, the third navy plane to try the flight from San Francisco to Hawaii

this in 26 hours, and last May the *PN-9* had already made a non-stop record flight of 28 hours and 35 minutes. The prevailing winds at that time of the year, coming mainly from the northeast at something like 20 knots were such as to help the fliers. The *PB-1* with its longer range was even better off.

The actual flight proved that the margin left was too narrow in fact, whatever it might have been on paper. Commander John Rodgers and his brave men met adverse wind when they were 1,300 miles from San Francisco, and were forced to use up their gasoline more rapidly than contemplated. Forced down by lack of fuel somewhere between 100 and 300 miles from the rocky and inaccessible coast of Hawaii, they tossed for nine days in the turbulent waters before being rescued. The second *PN-9* encountered piping trouble and turned back, and the *PB-1* was not allowed to try the trip when news of the first *PN-9* failure reached the Navy Department.

The lessons of the flight stand out very clearly. The sea must be treated with more respect, and long distance flights, in which gasoline may be exhausted too soon, should not be undertaken too lightly. It is gratifying to learn that these giant seaplanes, perfectly safe in the air, can also stand up under the pounding of the ocean. Nevertheless, designers might well turn their attention to the problem of greater safety in emergency landings, such, for example, as the quick detachment of the wings which, once the seaplane has alighted, are the real source of danger; or, alternatively, to the provision of sails for emergency navigation, as already tried out by the Germans in the Rohrbach seaplane, now also to be tested by the British Air Ministry; or, again, to the provision of an auxiliary engine, an auxiliary water propeller and water rudder, so that, with its wings gone, the seaplane might become a real water vessel, capable of taking care of itself for quite a long time. Such features involve considerable difficulty, but appear to be worth consideration.

Installing the Power Plant

WRITING in the *Technique Aéronautique*, M. Pierre Blanchet remarks with considerable truth that it is comparatively easy to design a model with excellent aerodynamic characteristics, but surprisingly difficult to build a good airplane!

In the early days of aviation, no particular effort was made to secure long endurance in flight. Provided the airplane could get off the ground readily and make a few turns around the airdrome, everything desired was achieved. Contrary to the present-day demand for accuracy, the motor of 30 or 40 horsepower with its small gasoline tank could be put into the ship in slapdash fashion.

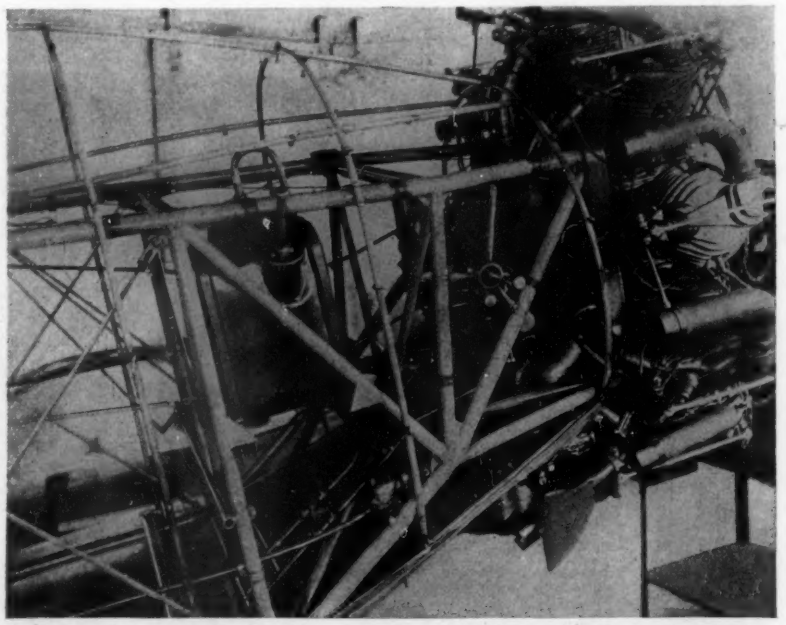
With motors of 400 horsepower and more, developing terrific energy and with non-stop flights of several hundred miles an absolute essential for commercial service, the problem of power-plant installation becomes one of supreme importance. And defects in the power plant are still the main source of forced landings with the troubles which always attend that feat.

The removal of such defects is, therefore, one of the most important problems of aviation. M. Blanchet gives a most thorough exposé of the entire subject.

There must be the maximum amount of accessibility and ease of inspection. The mechanic should be able, after turning a couple of wing nuts, to get at every part of the motor, particularly the carburetor, the magneto, and the gasoline piping system.

The gasoline system must be as nearly perfect as possible. The tanks should be as far as possible from the motor, free from leaks and instantaneously detachable in case of fire. The DH4's which our brave pilots flew during the war were familiarly known as the "flaming coffin." Their tanks were placed high in the fuselage between the pilot and the observer; a single unlucky bullet or a bad landing meant a terrible blaze of flame and a terrible death for two brave men. Now, tanks are made leakproof or crashproof; or else they are disposed in the wings on either side of the motor axis, so that they are not in danger of fire in a bad head-on landing; or else they are suspended low in the fuselage, and the turn of a single lever suffices to launch them into space. The gasoline piping is a matter of equal importance. Rubber connections wear out rapidly under the action of the fuel; rigid connections shake rapidly to pieces under the tremendous vibrations of the powerful engines. The French have developed a system of metallic, yet supple connections which are doing much to remove the danger at this point.

Every imaginable system of pumping the gasoline from the tanks to the carburetors has been tried out. The simplest system of all is one where the tanks are placed high enough so that gravity alone suffices to bring the gas to the carburetors. This entails a disadvantage, because the center of gravity of the airplane then comes far too high. A simple gear pump, like that used



An interesting example of engine mounting; installation on the Curtiss Carrier Pigeon. The system of tubing not only sustains the weight of the engine but counteracts the great vibration forces in play. When a part of the cowling is removed, almost every part of the engine becomes readily accessible to the mechanic. The air scoop of the carburetor is clear above the engine so that only air pure of gasoline vapor is received. The control wires at the side regulate the flow of air through the radiator. Note the enormous oil tank in the center of the photograph

for oil systems, driven by the motor, seems to give excellent results. Pumps must not only be reliable but must supply the motor with just the right amount of gas under varying conditions of consumption; there must be overflow returns and other devices. Mechanical ingenuity still has a great deal to achieve in the pumping arrangements.

Above all things, the air led to the motor must be free of gasoline vapor, or else there is serious danger of fire or even explosion when the mixture of air and vapor approaches sources of heat under the compact cowling. With the Junkers plane brought to this country for the Air Mail, such accidents were frequent at first, till American engineers redesigned the gasoline system, and introduced suitable outlets for gasoline vapor. Therefore, the air scoop should be outside the cowling and receive only pure, fresh air as the plane sweeps forward. When the military pilot flies at heights, or the commercial pilot for that matter, great cold must not freeze up the carburetor. Some method of preheating the air, therefore, becomes advisable to avoid this possible cause of seizure.

An automobile motor delivers very little power relative to its size and weight and the pressures on bearings and piston ends are comparatively small. In aviation motors, tremendous pressures come into play and lubrication must be well-nigh perfect. Particularly hard on the oiling system are the tremendous variations in temperature of the oil. High temperatures diminish the viscosity; low temperatures increase it to the point where the oil may cease to circulate. A system of temperature regulation has been devised by the Wright Aeronautical Corporation where the radiator water passes through the oil tank and helps to maintain the oil always at a reasonable temperature. Perhaps even better methods may be devised in the future.

An aviation motor is built of the best materials. Its materials are more expensive than those of even Rolls-Royce automobile engines. Nothing produces so much wear of this material as dirty oil. Filters will remove gross impurities, but not impurities which are dissolved in the oil. Here the principle of the cream separator has been employed by Army Air Service engineers, and centrifugal cleaners in the oil circuit have proved most satisfactory. This is a much better plan than frequent and wasteful drainage of all the oil in a power plant. And it also is a good plan to carry on board a large reserve of oil, in excess of what is theoretically necessary for a flight of a given duration.

Radiators sometimes cool the water insufficiently, when the plane is flying low and in hot weather. Or they may cool it too much, when the airplane is soaring to tremendous heights. Hence the mechanical engineer has stepped in with shutters which close off the cooling air, or movable radiators which disappear within the fuselage at the will of the pilot. Or the water flow may be shunted past the radiator when less cooling is required. The design of the cooling system may involve a mechanical problem of the greatest complexity.

Another tendency just beginning to manifest itself in French design is the introduction of automatic controls for the correct mixture of gas and air; for the correct temperature of the cooling water and for the provision of the right oil pressure and gasoline pressure. To ask the pilot who is busy flying the ship and meeting unexpected weather conditions to look after instruments such as oil pressure gages, gasoline gages, motor thermometers, and so on, at the same time, is taking for granted that he is almost a superman. Perhaps it will be possible to relieve him of all these troubles by using automatic controls. The difficulty is that each automatic device in itself introduces a chance of failure. Perhaps invention will bring automatic controls which are in themselves failure proof.

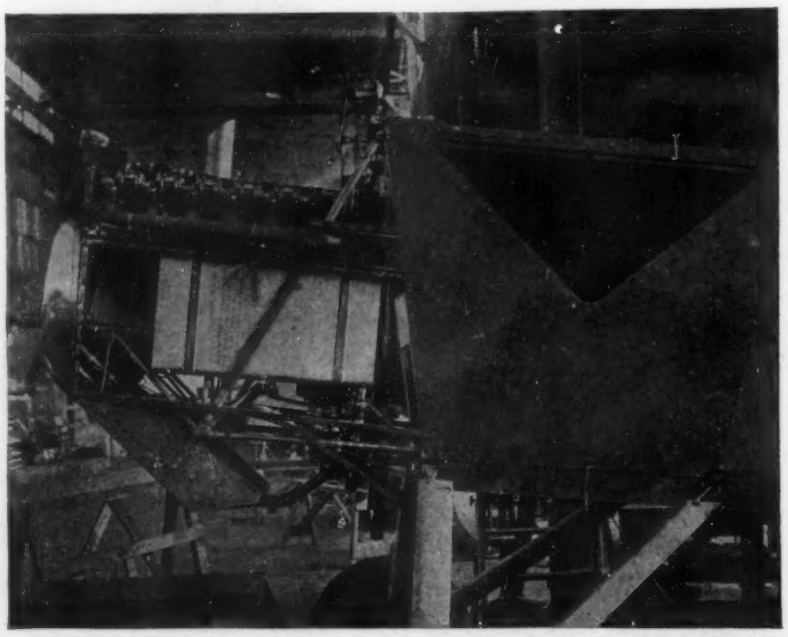
Finally, great attention must be given to the absorption of the vibrations of the motor. It is easy enough to hold up its dead weight. The average engine mounting could carry ten times the weight of the motor without a tremor. But the aero engine experiences forces in every possible direction, varying rapidly in intensity. The supporting structure must resist such forces adequately. And between the motor and its bed some shock absorbing material such as wood, cork or rubber must be introduced.

Novel Method of Air Cooling

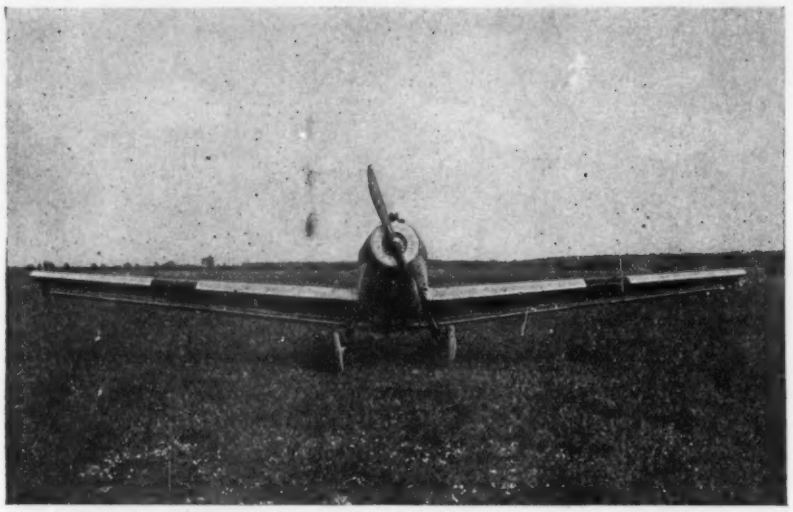
THE air-cooled aero engine, with fixed cylinders disposed in the form of a star around the crankshaft has reached a high form of efficiency and has many advantages as compared with the water-cooled motor—in particular a greater simplicity due to the absence of a radiator and water system. Its disadvantages are the fact that it has a large overall diameter and so impedes the vision of the pilot, and also the large aerodynamic resistance which the exposed cylinders offer to the wind.

The Junkers Aircraft Corporation in Germany has now brought out a type of aero engine, described in *Flugsport*, which has considerable novelty in the system of air cooling.

As plainly shown in our diagram and photograph, a fan or blower is fastened to the



A Wright "Cyclone," a 400-horsepower air-cooled engine mounted in a Douglas plane of the general type that flew around the world. This photograph gives an idea of the complexity of the problem of airplane power-plant installation



Front view of a Junkers plane equipped with an air-cooled engine and a special blower mounted on the propeller shaft. Note the peculiar slot in rear of the wing which provides increase of the maximum lift, somewhat like the Handley Page slot previously described in our columns

crankshaft just behind the propeller and drives the air into a channel lying in the direction of flight. From this channel the air flows into a series of passages, from the foot of the cylinders upwards, giving each cylinder efficient and above all *evenly distributed cooling*. The upper part of the cylinders are cooled by a series of fins exposed to the free air stream. This arrangement allows the air-cooled cylinders to be disposed in line just like an air-cooled motor and therefore removes the disadvantages we have mentioned as inherent in the conventional star-shaped motor.

Armstrong's Islands

STILL another plan for vanquishing the Atlantic by airplane has been worked out by an American engineer, E. R. Armstrong.

Armstrong's islands would be anchored at 500-mile intervals along the main route in the Atlantic. They would be huge masses of steel and masonry of about 15,000 tons displacement, 400 feet wide and 1,200 feet in length, with a landing deck 70 feet above the normal water level. They would be sustained by great buoys in such a manner that 95 percent of the total displacement would be below the "maximum wave-disturbance line," that is, far enough down to be practically uninfluenced by storms, wave disturbances being scarcely felt 50 feet below the ocean's water line.

The anchors would be attached to the anchorage buoys by steel cables, and at times allow the islands to drift a mile an hour without much strain.

Flying the Atlantic Commercially

WHILE the airplane is greatly superior to the dirigible in speed and handiness, it has not its range or carrying capacity, and if used for very long flights, it carries in its present form but little beyond the flying crew and the fuel. Its range and useful load can be increased by building bigger planes, but with present forms there is a limit to the size, because, as the size of the structure increases, so does its weight proportionately to the gross load of the machine.

European technicians, however, do not agree with the dictum that dirigibles are more likely to be used for transatlantic flight than airships.

Two interesting propositions of a totally dissimilar character are now before us. One is that of M. Louis Bréguet, a famous French constructor who has recently built a giant, four-engine, passenger-carrying plane.

M. Bréguet proposes to meet the increase in weight of the wings of a very large airplane by distributing the loads along the span. His conception is indicated in the artist's drawing. Eight propellers, driven by eight motors no doubt, are strung along the wings (such a multiple power plant would, of course, be an insurance against engine break-down). Therefore, the weight of the power plant and fuel is indeed well distributed. It will be understood that distributing the loads along the wing reduces the bending stresses.

The two main passenger cabins are also far from the center line and help to lessen the bending loads on the wings. Moreover, the airplane has grown so large that it has become merely a flying wing with cockpits, passenger compartments, power plant and wing bracing all concealed within the structure, parasite resistance thus being reduced to a minimum. Such a design, executed by highly skilled engineers is not beyond possibility. One of the most serious technical objections would be that owing to the very

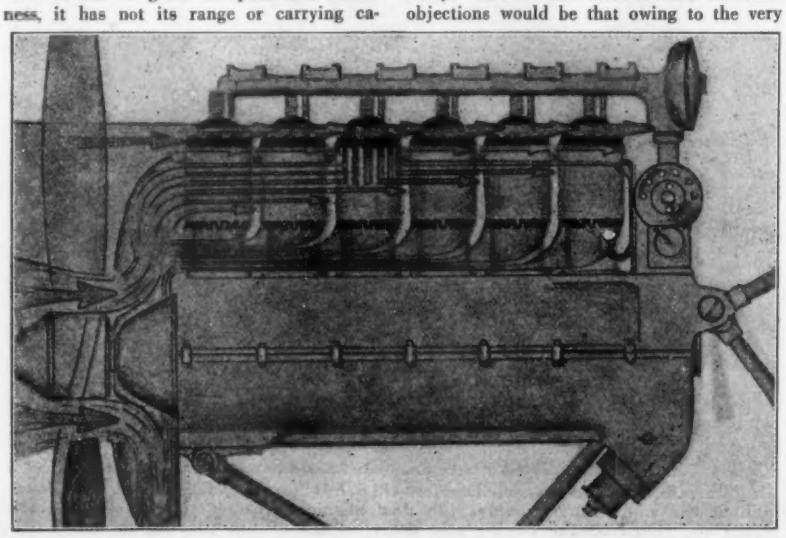
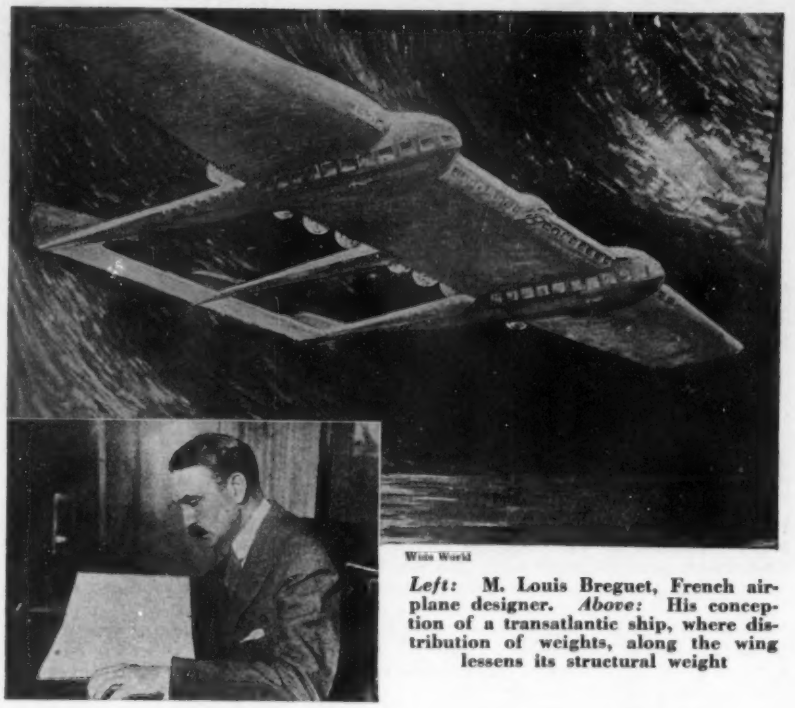


Diagram of the novel type of air-cooled motor, the Junkers L1



Wide World

Left: **M. Louis Breguet, French airplane designer.** ***Above:*** **His conception of a transatlantic ship, where distribution of weights, along the wing lessens its structural weight**

distribution of loads which is so desirable, the lateral moment of inertia would be increased and the maneuvrability diminished. But a large plane of this type does not need the agility of a small single-seater fighter, for example.

J. G. Navarro, a British designer of equal distinction, has presented to the Air Ministry in London a project of another character. He proposes to station in mid-ocean, some 330 to 400 miles apart, large ships 700 to 800 feet long, and 120 feet wide, which will not be anchored but cruise slowly within narrow limits. The flying boats to be used in the service will carry only sufficient fuel to negotiate the distances between the station ships, with a reasonable reserve. They will, therefore, have a large commercial carrying capacity. They will alight on the sea and take on fuel from the mother ships through pipes.

The project would mean London to New York in 46 hours, and London to San Francisco in four days, with the transatlantic line linking up with the New York-San Francisco air mail. The proposed fare of some $560 would not be so much higher than a first-class passage on a crack ocean liner.

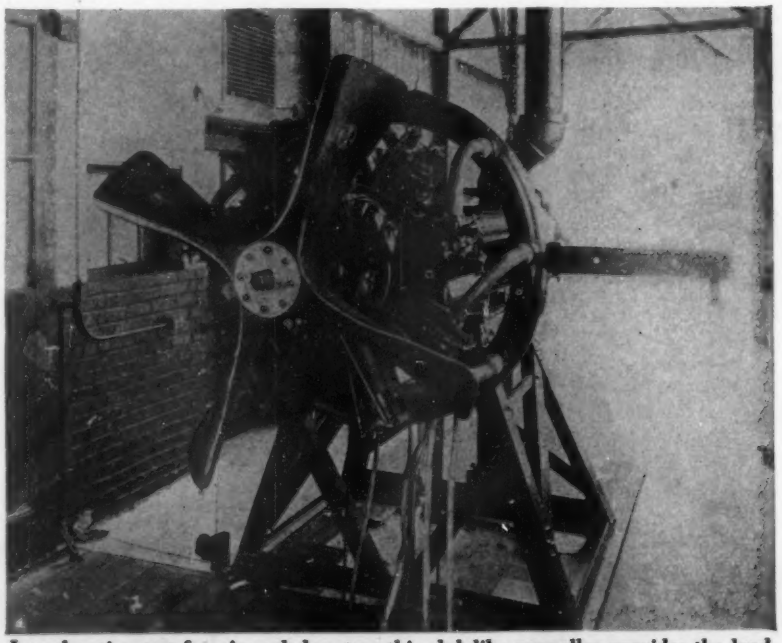
Testing Motors for Endurance

AIRPLANE motors must be as light as possible for a given horsepower and they must also be perfectly reliable. American engineers have recently achieved some remarkable endurance records, their engines standing up for more than 500 hours on endurance tests at full power. And they have devised some very interesting equipment for conducting such tests.

In the photograph is shown a duration stand for air-cooled engines built by the Wright Aeronautical Corporation. The engine is mounted on a cradle hung in ball bearings. A cable, shown at the lower left side of the photograph prevents the cradle from swinging and the force in the cable, measured on a scale, is also an indication of the torque or turning moment of the engine.

From the speed of the engine and the readings of the turning moment, the engineer calculates his horsepower.

The engine mounted on the air-cooled stand turns a pitched wooden club with four blades. The air is sucked from a wooden duct turned directly up and discharges into a similar duct.



In a duration test for air-cooled motors this club-like propeller provides the load and at the same time provides the flow of air necessary to cool the motor. From the speed of the engine and the readings of the turning moment, the engineer calculates his horsepower

The purpose of facing the ducts perpendicularly to the ground is to eliminate the strong currents of air which would otherwise flow through the yard, and carry sand and ashes with them, and also to direct the noise of the club so that it does not strike anything directly. With these precautions the long endurance test ceases to be objectionable; without them it would be unendurable for anyone working in the vicinity of the test stand.

A High-Speed Air Yacht for Mr. Vanderbilt

WILL the great bankers and sportsmen purchase specially designed air yachts as they order surface yachts? At any rate Mr. Harold S. Vanderbilt has set an example by having the Kirkham Products Corporation on Long Island build a flying boat of exclusive design for pleasure service along Long Island Sound.

The usual trouble with flying boats with wooden hulls is leakage and ready damage to the bottom; in the Vanderbilt boat a duralumin cover protects the bottom from such contingencies.

In this air yacht the wing flaps can be simultaneously depressed for landing or getaway, and are interconnected not with the elevator but with an adjustable stabilizer. There is thus center of pressure compensation, but at the same time the pilot can use his elevator without necessarily actuating the wing flaps.

Why does this flying boat, as do so many other flying boats, carry a four-bladed propeller instead of the more efficient two-bladed type? Because, to facilitate mooring at a quay, the propeller is a "pusher," placed behind the engine, and having therefore but little room for its swing. By using a four-bladed propeller it is possible to decrease the diameter without decreasing the thrust, and there is the answer to our question.

With the Napier Lion 450 horsepower engine, the flying boat can make a high speed of 145 miles per hour, and with fuel for 650 miles flight can land at the reasonable speed for a seaplane of sixty miles an hour.

Plan for Shortening the Landing Run

FROM the Aerodynamic Laboratories of Amsterdam we have received a description of a simple device to shorten the length of landing run. This consists of a series of shutters placed on the upper front surface of the wing, drawn into the wing in normal flight and erected after landing by a simple hinge mechanism.

These shutters decrease the lift of the wing by some 36 percent and increase the drag by some 98 percent. The airplane after landing, therefore, bears down more heavily on the ground, and the greater ground friction combined with the greater aerodynamic drag bring the airplane to rest much more quickly than without this device. Emergency landings in small fields are thus made far more practicable. Landings on ship deck also offer a possible application for the idea.

Ford Airline Costs

HENRY FORD is operating his airline between Detroit and Chicago as much to carry parts between his plants at either end as to obtain first-hand information regarding air-transport costs for future enterprises. The figures made public of a month's operation are most interesting.

The freight rate by rail for metal parts is 67 cents a 100 pounds between the two cities—and metal parts are the bulk of the air freight carried. The total cost by air was $12.25 per 100 pounds. But the Ford plane makes a round trip in six hours; delivery by any other means takes two days at least.

The air costs were accurately computed and took in gas and oil, labor, and depreciation of plane and motor. They did not, however, include many other items, particularly overhead, so that they would not be directly applicable to estimates for a projected airline.

Swimmers Take Heed!

Evidently because of the timeliness of the "Undertow" item in our August issue, our readers responded with much gusto. We think this reader's thought on the subject is in line with the average swimmer's experiences:

Editor, Scientific American.

Having just finished reading in the August issue of the Scientific American, an item entitled "Is the Steady Undertow a Myth?" in which are quoted the views of Professor Davis of Harvard, as published in *Science*, February 20, 1925, I feel constrained, in view of what appears to be the fallacious reasoning of Dr. Davis in that article to reply to his assertions and give my own views on undertow.

The article, as edited in the Scientific American, recites that the dread undertow of the ocean bathing beach is largely a matter of the bather's own psychology. Then follows this paragraph which is quoted verbatim:

"Most people think of the undertow as a strong, treacherous, steady current that is always trying to draw them out to sea. But Professor Davis asks where, if the undertow is the steady current it is reputed to be, does the water come from? It cannot run away from the land steadily unless it first comes in, and the evidence is that it does not come in with sufficient volume to maintain a steady outward flow around the bather's feet."

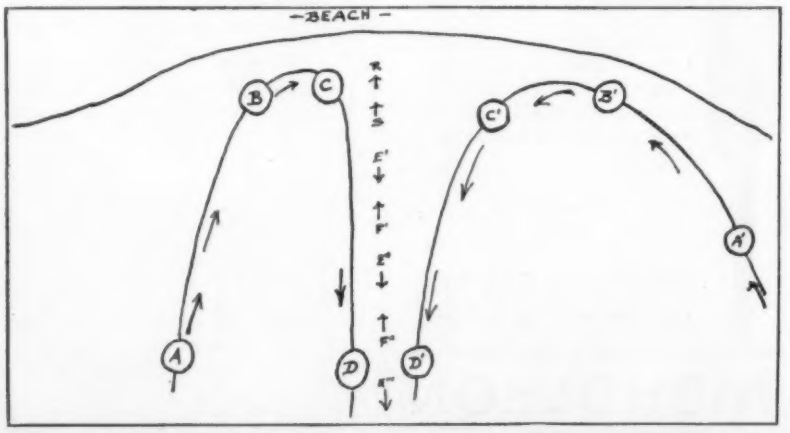
Professor Davis then suggests that the idea of a persistent undertow comes from the excited imagination of unpracticed bathers. He attempts then to show by diagram and explanation that the undertow is intermittent and that the action of the waves has a good deal to do with it. He submits "in evidence" a cross-sectional diagram, representing of necessity only two dimensions, that is, length and depth, (length meaning the distance from any particular point on the beach outward to a point in the ocean, and depth meaning the distance from the surface of the water to the sandy bottom), and attempts to show from and with that diagram that only the waves or the ebb and flow of the water have anything at all to do with the undertow.

We can gage fully the accuracy of the reasoning as a result of this use of the diagram when we note that Professor Davis has taken into consideration only a very narrow width of beach at the most. He should have taken into account the entire beach front and the probable conditions then and there prevailing.

Undertow is not necessarily caused by the swelling of waves at a particular spot, or by the ebb and flow of water. The sea is subject to all sorts of conditions and changes. This will be vouched for by many bathers; it will be acknowledged by physicists, who would regard the sea as a body of water which is subject to innumerable physical laws just as a glass or tank of water is, and would be agreed to by oceanographers, who are as familiar with the idiosyncrasies of the huge bowl of water known as the ocean, as good river pilots know the whims of the particular stream they are wont to travel over.

The ocean is particularly subject to changes occasioned by ocean currents and by temperature. As regards temperature, the physical principle of convection is involved. Warm currents are always present in the ocean, and bathers often strike these spots. These warm currents do not necessarily blend or commingle with the rest of the cold water, but follow definite lines within that water. These are the weaker currents that the bather feels.

Is it not then easily conceivable that some distance off shore a strong undercurrent of warm water may work its way shoreward? The passage of warm water causes a correspondingly strong flow of the colder surrounding water towards the warm water, so that there is a general flow of cold and warm water shoreward. But, the path of this undercurrent is not necessarily in a straight line. Thus, along a shore front,



Note, according to Prof. Davis, the letters near the short arrows indicate the following: R, the volume of water sliding back seaward after waves have broken against the shore; S, the next wave; E', the ebb of wave; F', the next wave; E", the second wave; F", the next wave, and so on. The other letters are explained in the article

as indicated in the diagram, although the waves may flow and recede, there may still be undercurrents, which travel in curves along the shore to and from the beach. These are the undertow and the physical action of waves can be and often is entirely independent of these undercurrents which may continue indefinitely.

The diagram also indicates the various actions of the waves as explained by Professor Davis. These are represented by the short arrows. Note that these are all in one direction, up and down on the diagram, or straight to and from the shore. The curved lines in the diagram indicated by A, B, C and D, and A′, B′, C′ and D′, represent undercurrents constantly curving into shore and incessantly passing out to sea. A person standing at D or D′ would feel these currents very distinctly. These undercurrents may be affected by the force of the breaking waves at the shore, so, that instead of completing their curve, they pass out to sea in a straight line. This straight current resulting from a continuous, curved current must be continuous since the source of supply is steady. However, whether the waves affect these currents or not matters little. The fact is that the undercurrents are there and they may curve out again to sea or go out in a straight line after following definite although apparently erratic courses through the ocean toward the beach.

To assert that there is no steady undertow or that it is merely fabulous, its presence being felt only by panic-stricken bathers, is altogether too dangerous a statement to allow to go unchallenged. It may give undue confidence to someone who, thereby convinced that there is no undertow, will venture further out than where he would ordinarily go.

Meyer Berman.

Four-letter Word Meaning a Bird

We are all prone to err—here is one on the editor:

Auckland, New Zealand.

Dear Editor:

With reference to your June issue, in the item, "The Airman's Slang," page 415, permit me to straighten you out with regard to the spelling of "Keewee." The "Kiwi" is a native of New Zealand and found only in this country.

"Kiwi" is pronounced exactly as you have it spelled. B. F. Cranwell.

Statistics on Our Navy Personnel

Our editorial on the Navy in the July issue brought forth from Commander John Stapler some interesting personnel statistics. The Commander does not quite agree with some of our remarks, and gives his reasons:

Dear Sirs:

My attention has been called to an editorial on page 12 of the Scientific American for July entitled "The Naval Conference Demobilized Ships But Not Men," which includes personnel statistics on the United States Navy, which I believe, in fairness to the Navy, should be commented upon.

The personnel figures to which I have reference are those included in the sentence:

> "Nevertheless, we are maintaining a Navy of 105,000 men (sailors and marines), and more than 9,000 officers, double the pre-war size and costing nearly 300 million dollars a year."

These figures of 105,000 men and 9,000 officers are evidently arrived at by combining 86,000 enlisted men for the Navy with 19,000 men of the ranks of the Marine Corps, and 8,000 officers in round numbers of all Corps of the Navy, with 1,000 officers of the Marine Corps.

On October 1, 1924, the strengths of the Treaty Navies on a basis of comparison in officers and men, exclusive of marines, were as follows:

United States		
Officers	Men	Total
8,148	86,439	94,587
British Empire		
Officers	Men	Total
8,669	93,297	101,966
Japan		
Officers	Men	Total
7,218	65,404	72,622

France

Officers	Men	Total
3,496	55,000	58,496

Italy

Officers	Men	Total
2,188	40,591	42,779

The Naval Reserves on the same date were as follows:

United States

Officers	Men	Total
4,014	22,905	26,919

British Empire

Officers	Men	Total
2,377	44,418	46,795

Japan

Officers	Men	Total
2,173	30,885	33,058

France

Officers	Men	Total
8,375	96,700	105,075

Italy

Officers	Men	Total
4,514	60,000	64,514

The comparative strengths of the two Marine Corps on the same date were as follows:

United States

Officers	Men	Total
1,166	19,500	20,666

British Empire

Officers	Men	Total
440	9,605	10,045

Of the above, 67 officers and 2,100 men were afloat for the United States, while 178 officers and 5,570 men were afloat for the British Empire. It will be noted that in the case of the United States, but a small percentage were at sea, the major part of the force being on expeditionary work, or at concentration points ashore. It is therefore evident that to include the Marine Corps in the strength of our personnel afloat, when comparing our Navy with that of the British Empire, results in a comparison which in fact is unfair to the United States. The comparison of the personnel strengths of the two Navies should therefore be based on figures exclusive of the respective Marine Corps. It is to be noted that the British Naval Reserves constitute a well organized and experienced force nearly twice that of the United States.

Another point that is worthy of consideration, is the difference between the two Navies in character of enlistment. The British Navy, with its high percentage of experienced and long term enlistments, has a distinct advantage over the United States Navy, with its short term enlistments, and high yearly turnover of men. A great deal of time, effort and personnel are required in the United States Navy to train recruits.

The article in question contains this sentence:

"Not yet have we demobilized our war personnel."

On November 27, 1918, when the United States Navy was at its greatest war strength, there were 10,409 regular officers and 21,618 reserve officers, making a total officer strength of 32,027. At the same time there were 215,817 regular enlisted men, and 291,866 reserve enlisted men, making a total enlisted strength of 507,683. The present enlisted strength of the regular Navy is about 84,000, while the enlisted strength of the Marine Corps is 18,500. The estimates for the British Navy 1925-26 show provision for an increased personnel of about 2,000 which will be very properly required by ships commissioning during the year.

In comparing the enlisted strength of a present day Navy with that of a pre-war Navy, it is to be borne in mind that for an equal tonnage, a larger personnel is required today, due to war developments in ordnance, fire-control protective fleet units and aviation.

In regard to the relative cost of our Navy today, as stated in the article "$287,000,000," compared with the cost of the United States Navy of 1914, $136,858,301, it should be remembered that the dollar in purchasing power today, is but a little more than half of what it was in 1914.

It is felt that in fairness to our own and other Navies these various items should be considered in connection with such an editorial as the one herein discussed.

(Signed) John Stapler,
Commander, U. S. N.

Science and Money

Mechanical Refrigeration a New Industry That May Affect Security Values

By Chase Donaldson

NEW industries that have all the earmarks of success should be closely studied by investors.

The manufacture of ice for domestic and commercial uses by mechanical means will probably experience far more widespread use over the next few years. Let us first trace the growth that has been experienced by this industry within the past few years and then let us attempt to relate the possible future growth to the securities of electric, gas, ice and other companies. It may also be possible to form some estimate of the kind of mechanical refrigerating unit that stands the best chance of success.

A Potential Market for 1,250,000 Machines

Considering solely the market for domestic mechanical refrigerating units the available market appears to be a long way from saturation. According to the *Electrical World* the number of domestic refrigerators now in use ranges between sixty-five thousand and seventy thousand. Production for the year 1925 is estimated at about eighty thousand machines, and for the year 1926 at about two hundred thousand to two hundred and fifty thousand machines. Various surveys of this potential market have been made and at present prices there appears to be possible the sale of one million or one million and a quarter domestic electric refrigerators. In addition to those homes which might use electrical refrigerators there must be considered those for whom gas-driven or water-driven machines are adapted.

At the present time the prices for the electrical units range upwards of $250, which, in the estimation of engineers who have studied the situation, limits the market to prospects with incomes of $5,000 or more.

What quantity production and lower prices can do to the available market cannot be definitely calculated, but it has been pointed out that in this mechanical refrigeration industry there lies an opportunity similar to the one that Ford embraced.

Application of Refrigeration Is Widespread

So far as the electric light and power companies are concerned, it has been estimated that the average residential customer's bill will be increased $10 per year by the use of an electric-driven refrigerator, which might mean as much as $50,000,000 a year from present domestic consumers. Another expert estimates that seventy-five thousand domestic refrigerators and twenty-five thousand ice-cream cabinets will be sold during 1925 which will give an added revenue for the central stations of $500,000 per year. Furthermore, the total annual revenue on all mechanical refrigerators sold by the end of 1925 would be $3,000,000.

The commercial applications of refrigeration are widespread indeed. It is only necessary to point out the more obvious installations, such as those in ice-cream parlors, butcher shops, florists' stores and dairies. The potentialities of applying a mechanical unit to refrigerating cars on railroads and to the manufacture of small water coolers have barely been touched.

The significance of the movement towards mechanical refrigeration is more fully disclosed in the periodicals of the artificial ice industry. That the ice man and his boss are concerned by the inroads that the mechanical refrigerator promises to make upon the artificial ice industry, is illustrated by editorials and very serious discussions in these trade journals of the ice industry; and even a larger degree of interest has been shown by the executives in the electric light and power industry.

An electric refrigeration committee of the National Electric Light Association presented a comprehensive report on the subject at the annual meeting in June. Difficulties with the mechanical features of much of the equipment now on the market have apparently held back the sales according to this report, and it was further pointed out that the question of service must be given first consideration if this particular industry is to progress.

The cost of this servicing has proved to be an item of considerable moment, and it appears that this cost increases year by year on the present type of machines. It is quite apparent from this report that the simpler the machine and the lower the cost of servicing, the better chances of success it will have.

As to the costs of operation of the electrical unit, conclusive data have not yet been compiled from enough sources, but for the average small installation it appears that the mechanical unit, including interest and depreciation on the investment, costs slightly more a year to run than does the purchase of ice.

Practically all of the electric-driven machines now on the market employ the compression cycle of refrigeration, and consequently, require an electric-driven motor and compressor, and either fans or a water-cooled condenser. It is in this very complexity of the mechanical equipment required that there lies the sales resistance and the expense of servicing.

The other methods of mechanical refrigeration, besides the compression system, are the absorption system, the vacuum system, the air system and the "vapair" system. All of these, with the exception of the one employing the absorption system, require an arrangement of motors, compressors, and so on, as is needed for the compression system. The absorption cycle which requires no motor but merely the alternate application of heat and cold to the refrigerating medium, has proved too costly for commercial use. It may be expected, however, that further development of this principle will compete with the compression machines, but no company employing this system has yet reached a quantity production basis. Such a mechanical refrigerating unit could use gas or electricity for the application of heat and would have a wider potential market than those driven by electricity alone.

Still another interesting development in mechanical refrigeration is a unit driven by a water motor instead of an electric motor.

Study Individual Companies Carefully

Turning finally to the effect of this new industry upon security values it appears that the electric light and power companies are in the best position to benefit in the immediate future, but the further possibility exists that gas and water companies as well will share in the revenues that may be derived from the more widespread use of mechanical refrigeration.

There are available several common stocks of companies which manufacture domestic and small commercial refrigerating apparatus. Several of the machines sponsored by these companies have been on the market for a number of years and rumors of expansion programs are current.

If one wishes to participate in the future of this industry a careful study should be made of the individual companies, particularly of the mechanical features, sales prices and costs of servicing of the machines. In the long run the mechanical refrigerating machine of the simplest design, lowest cost of maintenance and lowest market price will be the victor in the race for the attractive profits that await this new industry of mechanical refrigeration.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

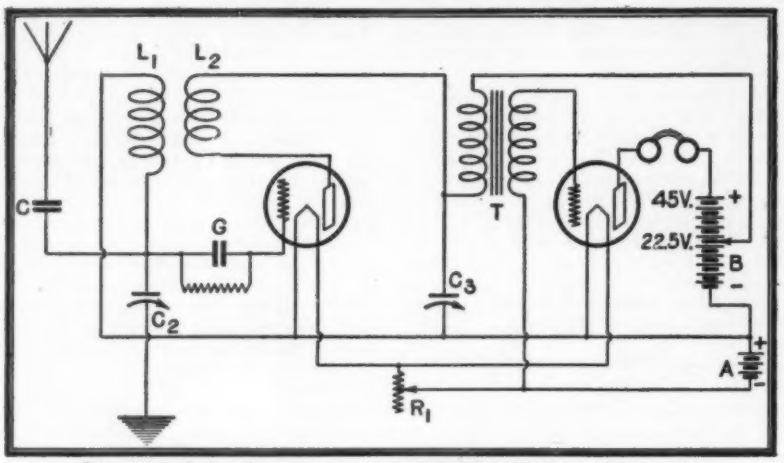


Diagram of the short-wave set of 9XH-9EK, Madison, Wisconsin

Short-wave Set of 9XH-9EK, Madison, Wisconsin

THE following is a description of the above diagram: C, antenna coupling condenser, consisting of two three-quarter-inch metal disks adjustable in binding posts. C2, low-loss, 3-plate variable condenser. C3, regeneration control condenser, .00025 mfd. capacity. G, grid condenser .00025 mfd. LI grid coil, diameter, 3 inches, Number 16 D. C. C. copper wire, Lorenze type. For 80 meters use 17½ turns; 40 meters, 7½ turns; 20 meters, 2½ turns. L2, is the tickler, diameter 3 inches, Number 16 D. C. C. copper wire, Lorenze type. For 80 meters, 9½ turns; 40 meters, 4½ turns; 20 meters, 3½ turns. RI, is the filament rheostat. T, a good audio transformer. R, a 9-megohm grid leak. The most satisfactory resistance will vary with different tubes, from 5 to 9 megohms.

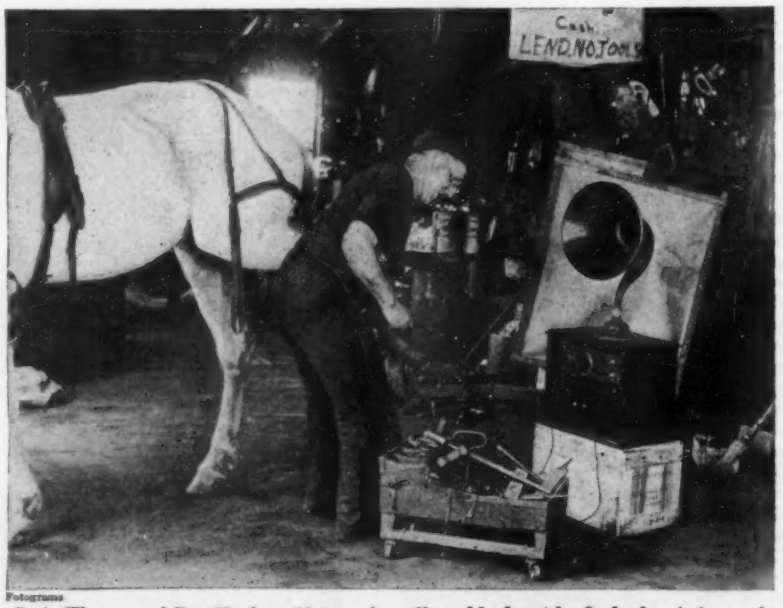
The coils for each wave band are fixed in position relative to one another by three glass rods and a few drops of collodion. All parts should be spaced away from the front panel so that body capacity will not interfere with tuning. This is especially true of the antenna condenser and grid coil. Every contact must be perfect. This applies to the tube prongs, rotary plates of the condensers and other friction contacts. Condensers having straight-line frequency characteristics are to be preferred.

Programs Recorded on a Steel Band

A STEEL band called a "radiofilm," is the basis of a new device produced by two Viennese inventors, Dr. Moreno-Levy and Franz Lornitzo, for the purpose of making a permanent record of radio programs. For example, if a broadcast listener hears a musical selection which appeals to him, he can adjust his receiver and the associated recording instrument to register the incoming impulses so that they can be played at will at any time in the future.

A steel band is passed through the magnet of the headphones. It preserves the magnetization. The reproduction corresponds accurately to the original broadcast, but it is feeble in sound. Therefore, in reproducing the program a diaphragm is not employed, but the winding of the magnet is connected to the grid of a vacuum tube in the receiving circuit in order to distribute the negative current.

There are two new and important factors: A special device of drums which permits the band to unwind repeatedly without tangling and the replacement of the steel band through a steel disk which is selected by a magnet in spirals. An adjustment allows the operator to fit the disk for running off in such a way that he need listen in to only those parts of the program which interest him. The rest can be



Fotogramas

C. A. Weaver, of Bar Harbor, Maine, the village blacksmith, finds that it is much easier to do his work to the accompaniment of radio music. He is shown here at work, while the radio entertains him

omitted just as one can skip the pages of a book. The steel band can be made receivable for a new transmission by demagnetization, which an inexperienced person can perform. The owner of a receiver can listen to a program in December which was broadcast and filmed in July.

The object of the radiofilm is to make all broadcasting performances independent of time and space; that is, to make them automatic. Just as the motion picture film can be reeled off at any time and any place, and can be repeated numerous times, exactly, in the same way the radiofilm is able to respect every broadcast, independent of time or place. As the motion picture film may be produced at any place over the face of the earth, just so the radiofilm is not a momentary improvisation, but a thoroughly prepared performance, which can be broadcast from any station in the world.

The steel band is magnetized according to the rhythm and strength of the sound waves and fixes it as an acoustic film for the purpose of indefinite repetitions. Thus the performance is made independent of the actor; the listener is made independent of the moment of transmission, because he is able, through an apparatus connected with the receiving set, to repeat the acoustic film as often as he desires, and at any time.

The inventors claim that the radiofilm is not only able to fix acoustic phenomena but also to fix photographic pictures which, once taken, can be repeated at any time and as often as one chooses. The radiofilm, therefore, can be used as an acoustic and photographic record.

The work in the broadcasting studio, whether it is a concert or play, finds a solid basis through the radiofilm. Instead of a performance being dependent upon the momentary mood of the artists, there can be fixed on the steel band a performance representing the maximum effort, improved and crystallized through rehearsals, obtained by a finished working out of the concert or drama. Thus, the staging and broadcasting can deviate from the example of the theatre, in order to approach the working methods of motion picture staging.

Just as a motion picture after its production in studios is presented in one and the same form to audiences throughout the world, and as many times as the interest in the picture warrants, just so the radiofilm can be created in proper studios and sent to all the broadcasting stations of the world, and from their aerials to auditors in a definite and permanent form.

The inventors point out that this method of presentation will lift the quality of broadcasting; minimize the number of performances; and eliminate less talented entertainers. For example, a certain musical or theatrical performance of high quality could be produced alike for all countries.

Exchange of films on an international scale is made possible. Just as a motion picture theatre can show an American picture followed by a German one, so in radio, will broadcast events be exchanged, and thus will grow a varied program capable of competition.

Radiofilm studios can be completely separated from the broadcasting stations just as motion picture studios are not a part of the theatres to which they furnish only the ready-made reel. It is the plan of the inventors to have a central office from which the radiofilm can be procured by broadcasting stations.

How to Stop Electric Signs from Interfering

FLASHES from electric signs often cause interference for broadcast listeners in cities. This type of disturbance can generally be prevented by connecting condensers of from one-half to two microfarads capacity across the contacts of the circuit breaker. It is sometimes necessary, however, to add a choke coil at the line side of the circuit breaker and also connect the condenser across the contacts of the circuit breaker. As the interference from such sources de-

pends upon the conditions of the installation, it is necessary to make these few experiments, in order to eliminate the interference most effectively.

Interference from a flashing sign has sometimes been caused by sparking at the motor commutator, which drives the flasher. This may be determined by the nature of the noise in the receivers and can usually be stopped by reversing the leads to the motor.

Static Made Constantly

THE Blue Book of the Meteorological Office of the British Government states that there are at least 100 lightning flashes every second, year in and year out, winter and summer, somewhere in the world. The world experiences 16,000,000 thunderstorms a year, or an average of 44,000 a day, according to the book. It is calculated that in any given second there is released from the clouds more energy than the world's water-power stations produce in six months.

Undersea Telephony

A METHOD has been developed by the United States Navy for conducting underwater communication by sound telephony. It utilizes high frequencies, above the audible range of the human ear approximately 30,000 vibrations a second. This makes it possible for the officers of two submarines to talk to each other, while submerged, obtaining, as in broadcasting, every inflection of the voice.

Static Travels West With the Sun

A COMPREHENSIVE research, extending over three years and culminating in a cruise around the world, gave the Marconi Wireless Telegraph Company, Ltd., an opportunity to study static disturbances. The usual salvos of grinder static were picked up in the tropics along with other types of static, causing crashes and clicks in the headphones.

The observations indicated that static is produced over large areas of land in the tropics and the noises seemed to reach a maximum at about 3:00 P.M., local time. The general direction from which the continuous static arrived was determined by loop antennas. The sources varied with the seasons. During the summer in the southern hemisphere, the grinders came from South Africa, Australia and South America, never from above the equator. It was found, as the ship cruised homeward, that the source of static moved westward with the sun.

New Device Keeps Wavelength Constant

INTERFERENCE, caused by a broadcasting station being off its assigned wavelength, is doomed by a new device which automatically holds a station to a fixed wavelength or frequency, much the same as a balance wheel dictates the speed of a watch, or a governor regulates the speed of a steam engine.

This device, now installed at KDKA, consists of a piezo crystal, ground to a certain size and general form, and placed in a specially designed transmitting circuit. The size and shape of the crystal governs the wavelength of the transmitter and holds it constant. The only way to alter the wavelength is to replace the crystal or grind it to another size. The crystals can be made for use on any wavelength.

Crystals which have the power of vibrating at frequencies in the radio range are called "piezo crystals." KDKA's engineers learned that the frequency at which the crystals vibrated was governed by size and shape. They also discovered that, by using the crystal in a specially constructed circuit and building the oscillation on up through the high-power transmitting set, the wavelength emitted is exactly the same as that of the crystal. No ordinary change in

Kadel and Herbert

A unique system for marking where the various radio broadcasting stations come in on the dials has been devised and is being used by George Jacobson, of New York. The photograph illustrates the layout. The inventor indicates by paper markers the dial location of each station, and he notches the piece of sheet copper, shown fitted into a slot that covers the face of the calibrated dial. His indicator is attached to the knob of the dial, and he tunes into any station he wants by simply adjusting the indicator into the notch of that station

the adjustment of the transmitter can cause any appreciable change in wavelength. The use of the crystal is said to improve the quality of transmission by reducing the amount of distortion. The crystal used at KDKA is about the size of a half dollar.

Army to Train Amateur Operators

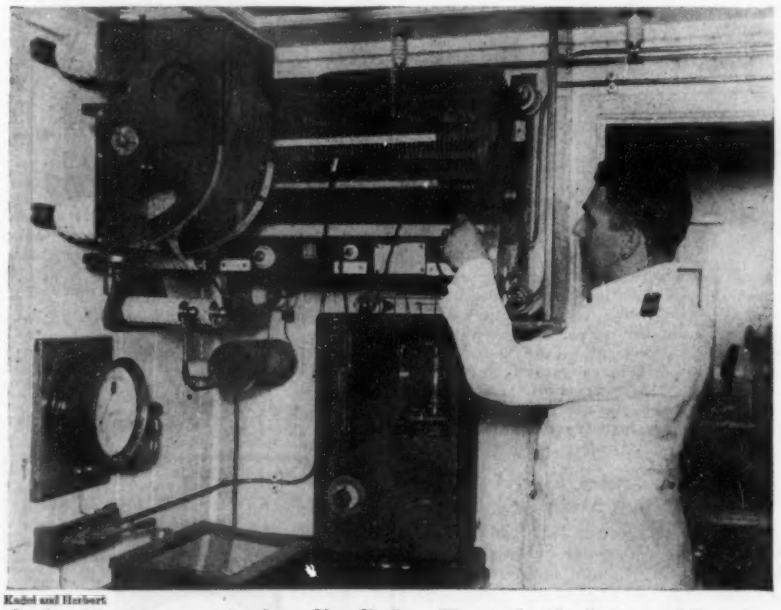
THE War Department has authorized plans for the establishment of a corps of civilian radio operators trained in the methods of the army, and the organization of a complete network of army-amateur transmitting stations throughout the country. The American Radio Relay League has been asked to represent the amateurs in organizing the plan.

The League will enroll its members into various nets which will comprise the system. These amateurs will be asked to act as communicating stations for battalions, regiments, brigades, divisions, and corps-area headquarters. Each corps-area headquarters will be linked up with all of its subordinate units.

It is the hope of the Signal Corps that the plan will build up a strong defense unit of civilian radio stations that will be able to function when land lines are down because of storm, civil commotion or actual warfare. At the same time it is expected to provide a large reserve of radio operators, trained in army procedure and in the basic principles of using radio in the field.

Direction of the various nets in the corps-area headquarters will be carried out by a liaison agent at the Signal School, Camp Alfred Vail, New Jersey, where the central control of the entire system will be located.

In order to generate the necessary amount of traffic to properly initiate the amateurs into the methods of handling army material, routine reports of National Guard and Organized Reserve Units will be transmitted by radio. It is also planned to send as much official correspondence as possible through these stations.



Kadel and Herbert

On her latest eastern trip, from New York to Plymouth, Cherbourg and Bremen, the North German Lloyd liner *Columbus* conducted a series of tests with a powerful new radio telephone. It is stated that successful conversations were held with shore stations in England and in Germany and also with other ships at sea, but the value of these tests and the efficacy of the radio telephone as a means of communication at sea cannot be determined until more specific and detailed reports of the tests are given out. The photograph shows the antenna tuning coil. This is of tapped construction and, to offer greater selectivity, a huge variometer of special construction is used. This can be seen in upper left

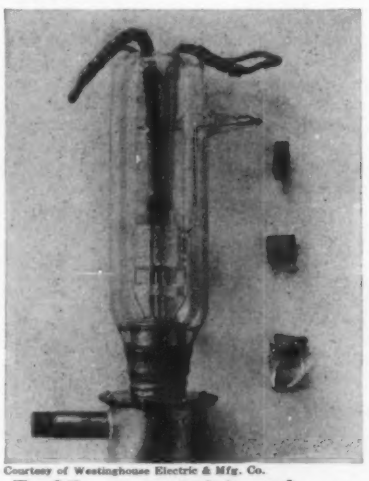
In presenting the plan to the American Radio Relay League, Major General C. McK. Saltzman, Chief Signal Officer of the Army, said, "This plan should within a year or so provide the United States with a vast number of radio operators of potential value to their communities and to the nation in an emergency."

New French Regulations

AN order now effective in France requires that ships with 2,000 gross tons or more, carrying fifty persons, including the crew, and ships having more than twelve passengers, must be equipped with a complete radio-telegraph installation. Ships with 500 to 1,999 tons, carrying less than fifty persons, and ships of the same tonnage with the number of passengers not exceeding twelve must be equipped with a receiving set only.

How to Restore a "Dead" Tube

DR. CHARLES B. HURD, of Union College, in a broadcast made from WGY, said, "A vacuum tube works because the hot filament gives off electrons, those small unit charges of electricity so important in all electrical processes. Some metals such as thorium, give off these electrons more readily than does tungsten. Hence, if thorium is present on the surface of the tungsten filament as in thoriated tungsten, lower temperature can be used, resulting in longer life for the tube. Some who burn filaments too brightly destroy the coating of thorium on the surface of the filament, after which the tube becomes poorly sensitive or "dead." If in addition the tube has been worked for a long time at too high a temperature, the thorium may have been all driven out of the tungsten. If such is the case the tube is ruined. But, if the thorium is only driven from the surface, some of the thorium remaining in the interior will come out on the surface by burning the filament very brightly for a short time, with the 'B' battery disconnected. The tube will then work efficiently."



Courtesy of Westinghouse Electric & Mfg. Co.

Ten-kilowatt transmitting tube contrasted with the Piezo crystal used in the Westinghouse transmitting station to hold the wavelengths of the various stations on their assigned frequency. It is estimated that by eliminating the variation from assigned wavelengths ninety percent of present day interference will be avoided

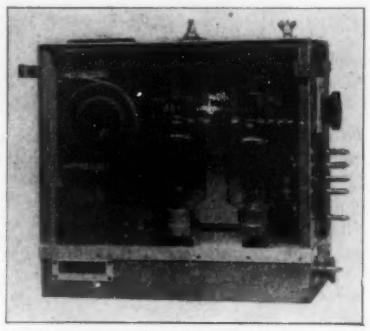
Light Companies Find Interference Sources

THE National Electric Light Association has completed a thorough investigation to trace the causes of radio interference and the best ways of eliminating annoyances produced by stray sparks.

The spirit of the electric light and power companies is reflected in their statement, "There should be no argument or discussion or attempt to evade responsibility when there is reason to believe that the equipments and circuits for which an electric utility is responsible is causing the interference. It is only by accepting responsibility,

and either definitely satisfying themselves that their circuits are not to blame, or clearing the trouble, that the utilities can secure and hold the confidence and respect of the community."

Some of the chief sources of interference outlined in the report of the investigation may be helpful to radio fans in locating noises which creep into their loudspeakers. These are: power lines, defective insulators, faulty lightning arresters, transformers, generators and motors, induction voltage regulators, arc lights, light switches, X-ray machines, storage battery chargers, annunciator systems, stock tickers, ignition systems, electric elevators, electric furnaces, moving picture equipment, electric flat irons, electric heating pads, violet-ray devices, door bells and high-voltage testing equipment, telephone and telegraph lines, pole changers and converters, street cars, electric railroads, smoke and dust precipitators and sign flashers.

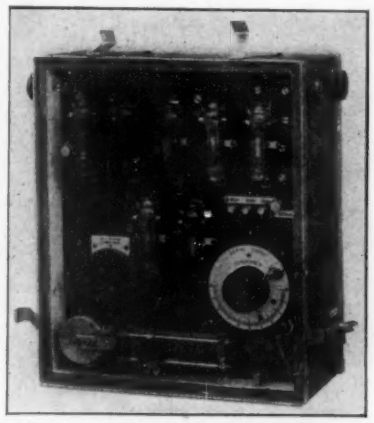


The transmitter of the new Marconi radio outfit for inter-airplane communication while in flight

Radio for Inter-airplane Communication

COMPACTNESS of apparatus is essential in airplanes so Marconi engineers have perfected a short-wave set in which no trailing antenna is required. A fixed aerial is fitted around the fuselage of the plane.

The transmitter and receiver can be mounted as separate units and the complete kit weighs 57 pounds. The wave range of the outfit is from 75 to 140 meters and its communication range approximately five miles, sufficient to enable all units of planes in formation and squadrons to keep in perfect liaison.



The receiver of the new Marconi radio outfit

Listeners Broadcast via the Telephone

AN attractive method of securing the attention of listeners to educational broadcasts has been tested at station 5NG, Nottingham, England. Professor Peers of University College at Nottingham, suggested that a series of talks and discussions be broadcast, with a group of students contributing the discussion in the studio.

These discussions were used to arouse interest among the listeners and then it was agreed to receive questions by telephone and to pass them into the studio on slips of paper to be discussed by the students. The

Courtesy of General Electric Co.

This receiving station at Schenectady intercepts the short wavelength signals by means of a loop and measuring instruments indicate the field strength. Note the three different types of loop antennae, one of which is a spiral of metal tubing

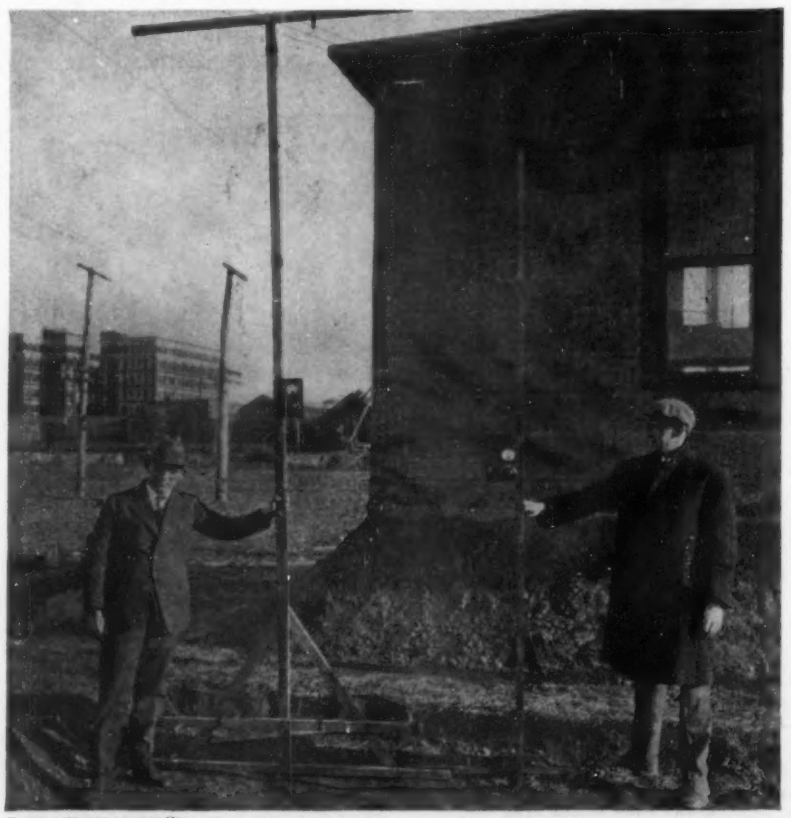
next step was to let the radio fans take part in the discussions and a telephone line was connected through an amplifier to a loudspeaker in front of the microphone. Questions asked by radio listeners were broadcast as well as the answers. In a short time the invisible class monopolized the entire discussion and the studio class was dismissed.

$500,000,000 Sales Predicted for Radio

THE retail value of radio receiving sets and parts to be sold in 1925 is estimated at $500,000,000, compared with a value of $50,000,000 for apparatus sold in 1922, according to a survey of the radio industry just completed by the Copper and Brass Research Association. It is pointed out that in 1922 there were hardly 100,000 receiving sets in use. In 1923 the number had increased to 2,000,000 and by the end of this year it is calculated that 5,000,000 receivers will be in service. These figures illustrate the remarkable expansion in the radio industry during the past four years.

Public interest in broadcasting has gained rapidly and apparently has continued unabated, according to the association. Only a year ago the demand was far in excess of the manufacturers' ability to supply. At that time home-made sets exceeded the factory-made and there was a correspondingly large retail market for radio parts. The last year has witnessed the beginning of stabilization of the industry. The trend is now away from the home-made sets toward the receivers purchased as complete units.

The present rate of manufacture, according to the survey, indicates that 1925 production will be 2,000,000 sets, in which the consumption of copper and brass will be about 7,500,000 pounds. These metals



Courtesy of General Electric Co.

WGY's exploring antennae are used to measure the intensity of broadcasting stations

New Type of Tube Give Greater Volume

THREE new vacuum tubes, designed for use as audio-frequency amplifiers to produce more volume than previous models, have been placed on the market by the Radio Corporation of America. The UX-120 is a dry-battery power amplifier requiring 135 volts on the plate and 22½ volts grid bias. When connected to the last audio stage it provides loudspeaker volume approximately double that obtainable from the storage-battery type of receiver using 201-A tubes.

The UX-112 is a storage-battery tube requiring 135 volts on the plate. It gives loudspeaker volume much in excess of that obtainable from a 201-A tube in the last audio-amplifier socket.

The UX-210 produces greater volume than any type of audio amplifier heretofore introduced. It may be operated directly from a 6-volt battery with upward of 150 volts "B" battery. It may also be used as a 7.5-watt transmitting tube.

Two types of rectifier tubes have also been introduced for use in "B" battery eliminators and current-supply devices. One tube, known as UX-216-B has an output of 65 milliamperes. It is a singleway or half-wave rectifier. The other tube is called UX-213. It is a doubleway or full-wave amplifier which provides an output of 65 milliamperes for "B" battery eliminators and current-supply devices.

These tubes are all equipped with the UX type of base, that is, the "push" type which has been adopted as a standard.

Wave Propagation Not Yet Understood

PHYSICAL conception of wave propagation up to the present is rather vague and not much advance has been made in the understanding of the physical phenomena involved since the formulation of the Faraday and Maxwell theories, according to Dr. E. F. W. Alexanderson. But he believes that recent discoveries in physical science will soon give a new understanding of these phenomena.

"It is assumed that radio waves are of the same nature as light waves," said Dr. Alexanderson. "The gap between the longest light and heat waves and the shortest radio waves is closing up. Modern science, however, denies the existence of the ether. We have tentatively substituted a conception of an electromagnetic field in which the energy appears sometimes in electric form, and at other times in magnetic form. This is a mathematical rather than a physical substitution, but it is convenient because it permits the use of equations for the electric and magnetic fields used in electrical engineering. It is, however, not an explanation. To an electrical engineer a magnetic field is very real, and it is in its nature quite different from an electrostatic field."

Radio Merchandising

THE future of successful radio merchandising lies in complete receivers, is the opinion of G. E. Brightson of the Brightson Laboratories. He said, "The trouble today is in the fact that radio manufacturers have been content to make and sell a receiver, letting the rest of the necessary accessories be chosen at random by the purchaser. In other words they have allowed cheap and unmatched spark plugs to be placed in a fine motor."

THE SCIENTIFIC AMERICAN, December, 1925. Volume 133, Number 6. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

FAITH

BE sure to read the article by Professor Klemin on the late aviation meet which, apart from its excellence, possessed special interest for the Scientific American because one of its contests was for a prize given by this journal. In limiting our offer to small planes of 20 horsepower or less, we were mindful of the fact that in the early days of the development of the airplane, at least so far as the United States is concerned, the work was done by individual enthusiasts who put their own time and their own, often very limited, means into the construction of small airplanes.

Many times, in those early days, we journeyed down to Long Island to see what new planes were in the making; and looking back, we feel a very profound respect for the men who, with a few sticks of spruce, a few yards of fabric and a reel of wire, were not afraid to tackle what we now know to be one of the most difficult problems in the world—the production of an improved airplane.

Some of those early experimenters held on with large faith and bulldog tenacity; and today they reap the reward of a fame which is world-wide. Others fell by the wayside, with nothing to show for their work but a "crashed" plane and an empty pocket.

GASLEGGERS

MOTORISTS who like to take their gasoline straight now learn that bootleg filling stations have been putting something over on them. The Tidewater, Standard Oil, Gulf Refining and other companies report that dealers with recognized, big-company tanks have been dispensing a bootleg produce made of cheap gasoline mixed with kerosene. The tanks are filled at night by gasoline runners, the dealer covering his tracks by buying a small quantity of the trademarked product he poses as selling.

The public buys the stuff because of the name; a synthetic substitute is provided by a runner under cover of darkness; the manufacturer tries to protect the consumers by using a non-refillable bottle, or rather by placing a seal on the tank.

Where have we heard all this before?

CIRCULATING

"A FINANCIAL authority calls attention to the fact that the business of the country is being run on only $5,000,000,000," said the "Science and Money" editor. "It hurls itself from place to place fast enough to furnish working capital for industry and agriculture, capitalized at $125,000,000,000. Every dollar in the United States has to do the work of $40 at high speed.

"Now isn't a dollar just like a copy of the Scientific American?" replied the circulation manager. "Everybody wants it; there are not enough to go round, and each one of them gets used by a lot of people."

"Yes," chimed in the "Digest" editor. "And just try to borrow one if you want to find out how popular you are."

In This Issue

Can American Aviation Outdistance Europe's?

Professor Klemin of our staff, an official at the recent National Air Race, believes we can keep up with Europe's airplane development. He saw all the races and what he has to say about them and the planes which flew in them is one of the most interesting articles we have printed in a long time. Page 365.

Spirit Photographs?

Dr. Walter Franklin Prince, Research Officer of the Boston Society for Psychic Research, tells how Sir Arthur Conan Doyle and other proponents of spirit photography are hoodwinked. Page 370.

Indicators to Find Riches

Can they find gold, oil, coal—even buried treasure—with any known kind of scientific indicating device? Are those about which we hear truly genuine—or are they all a hoax? The answer, given by A. G. Ingalls on page 372 is "Yes and No." That is, you can locate some minerals with some instruments. Others are 100 percent hocus pocus.

An Electric Eye Which Excels the Human Eye

The human eye can distinguish between but eight shades of color. Now, however, comes an electro-mechanical device which demonstrates that it can sort cigars into thirty different nuances of color. Here is a machine that is truly more than human. See page 386.

What Makes Radio Signals "Fade"?

Our old enemy, radio fading, is caused by a layer of helium and oxygen, some sixty-odd miles up in the air, according to several recent scientific experiments. "Now that we know it, what are we going to do about it?" There is the crux of the matter. See what Mr. Dunlap has to say about it on page 378.

MORE THAN 150 PICTURES

Complete table of contents will be found on page 432.

For Next Month

The Automobile of 1926

H. W. Slauson, who is already known to our readers through his articles on traffic problems, is preparing a comprehensive article dealing with the mechanical improvements which will be embodied in the 1926 automobile. If you are contemplating purchasing a car, his article will be invaluable to you.

Our Newest Indian Problem

Last year full American citizenship was conferred upon all of our Indian wards. But does that solve the Indian problem? Most emphatically not, says Jennings C. Wise, a well-known lawyer who is now representing the Indians before the Supreme Court of the United States. It gives us a new problem which must be solved quickly for the good of both the white race and the red.

Cleaning Kilns of Clinkers

Six different cement-making plants each hire a man with a gun to shoot clinkers out of the kilns. The need for this, the novel gun and the square-nosed bullets employed make an interesting story.

"Englishmen" Before the Glacial Period

England, a tropical country about a million years ago, was peopled by the earliest men we know of. Then came the ice cap which drove them out and kept them out for 100,000 years. The story of that primitive race, revealed by their flint tools, is a fascinating one.

Other articles on Monoxide Poisoning; Seeing Speech; Wintering Habits of Insects; Radio; Astronomy.

MORE THAN 150 PICTURES

¶ ***Last month at many of the newsstands all the copies of the Scientific American were gone within three days after they were placed on sale. Better make sure of getting your copies.***

A trial subscription for three months costs only a dollar.

HELLO

EMBASSIES and consulates, university scholarships, lecture tours, propaganda—all have had for years as their supreme object a better understanding, a closer friendship between America and the Old World.

Now comes the announcement that soon you may pick up your telephone and talk with a man in London as easily as if he were in the next street. What is more, you can do this at a cost of five dollars for three minutes. Here is an achievement which outweighs a century of striving for international accord.

When men talk directly to one another easily, cheaply, and constantly about their daily affairs, they talk the same language, they have the same ideals. It is becoming more and more difficult for them to misunderstand each other. As an insurance of peace, the inauguration of the five dollar-for-three-minutes transatlantic telephone rate may well rank with the best treaty ever signed.

REALIZATION

AS George Campbell Carson, former itinerant miner, lay on a hospital cot, they brought him word that the Court of Appeals had affirmed the judgment in his patent suit for millions against the American Smelting and Refining Company. They pictured to him travel, yachts, motor cars, country mansions, liveried servants—all the supposed pleasures that go with wealth.

But Carson had a truer vision.

"No," he said, "all I want to do now is to develop my interest in science. All my life I have been interested in science. I've always wanted a little workshop and a laboratory. Now I'm going to have them. With that little laboratory—well—who knows what I may be able to do? Maybe something that will result in good to humanity."

STUCK!

HOW many people in this glorious city of ours realize that within a few years, four or five at the outside, this city is going to be so congested in its main traffic lines that transportation, at least in the rush hours, will be absolutely stuck fast. We say this advisedly. It will take at least five, more likely six years, before any new subways can be in operation. The past few years have been spent in vain talk and needless recriminations. "Katy did —Katy didn't" never built subways; and although, as everybody knows, blame for the delay rests upon our inimitable mayor and his one-time faithful cohorts of Tammany Hall, that does not change the fact that New York City is facing a veritable *impasse* in transportation.

INDICES

DUE to lack of space the indices for the volumes of 1925 have not been published in the magazine. We now have printed a limited edition of the indices for the two volumes of 1925 which can be supplied, postage prepaid, for 10 cents each.